Manitoba
Culture, Heritage
and Recreation
Historic Resources

PAPERS IN MANITOBA ARCHAEOLOGY

FINAL REPORT NUMBER 18

HILL OF THE BUFFALO CHASE 1982 EXCAVATIONS AT THE STOTT SITE, D1Ma-1

by
Patricia M. Badertscher
Linda J. Roberts
S.L. Zoltai

87-04904/

IMPORTANT

Archaeological sites constitute a very fragile resource that requires careful handling. Archaeologists have devised a wide range of methods and techniques whereby archaeological information can be gathered from the field in an orderly and scientific fashion. Inasmuch as such activity invariably affects what we stand to learn about our heritage as Manitobans, it is incumbent upon the Province to ensure that these resources are handled properly via these special methods and techniques. To that end, anyone wishing to collect or excavate for archaeological objects is required under Section 53 of the Heritage Resources Act to obtain a permit from the Province to do so. This allows the appropriate officials to specify the nature of the work to be done in light of the collector's or excavator's qualifications and experience. Such a permit may also stipulate that the results of investigation must be reported to the appropriate Provincial agency. If all findings are so reported, there exists the opportunity to have new information studied and presented to the public by a central authority established for that purpose. The book you are now reading is a case in point.

If, quite by accident, you come upon an archaeological object, or an item that you suspect is an archaeological object, you are required under Section 46 of the Act to report the discovery to the Minister. If it appears that the object is still in place in the ground, that is, it has not been totally displaced from its natural setting or stratum, it should be left there and the Minister informed of it. Such a discovery could prove very important to our understanding of local or regional history.

For further information, please contact:

ARCHAEOLOGY SECTION
HISTORIC RESOURCES BRANCH
MANITOBA CULTURE, HERITAGE AND RECREATION
177 LOMBARD AVENUE
WINNIPEG, MANITOBA R3B 0W5
OR PHONE
945-4392

* * *

FINAL REPORT NUMBER 18

HILL OF THE BUFFALO CHASE
1982 EXCAVATIONS AT THE STOTT SITE, DlMa-1

by

Patricia M. Badertscher
Linda J. Roberts
S.L. Zoltai

Historic Resources Branch
Manitoba Culture, Heritage and Recreation
1987

Canadian Cataloguing in Publication Data

Badertscher, Patricia M.

Hill of the Buffalo Chase : 1982 excavations at
the Stott site, DlMa-1

(Papers in Manitoba archaelogy. Final report ;
no. 18)
Bibliography: p.
ISBN 0-7711-0136-8

1. Stott site (Man.). 2. Manitoba -- Antiquities.
3. Indians of North America -- Manitoba --
Antiquities. I. Roberts, Linda J. II. Zoltai,
S.L. III. Manitoba. Historic Resources Branch
IV. Title. V. Series.

E78.M25B32 1987 971.27'3 C87-099300-3

TABLE OF CONTENTS

PAGE

ACKNOWLEDGMENTS v

LIST OF FIGURES ix

LIST OF TABLES xv

INTRODUCTION 1

CHAPTER I: FIELD STRATEGY 13

- Research Design 13
- Survey and Mapping 16
- Methodology 19

CHAPTER II: LANDSCAPE EVOLUTION, STABILITY AND AGE ASSESSMENT 25

- Hydrology and Landforms: The Aging Landscape 25
- Depositional Materials, Environment and Soil Formation . . . 40

CHAPTER III: FAUNAL RECOVERIES 109

CHAPTER IV: CULTURAL MATERIALS 140

- Ceramics 140
- Lithics 205
- Fauna 259
- Features 274

CHAPTER V: INTERPRETATIONS AND CONCLUSIONS 317

ADDENDUM 351

REFERENCES 363

APPENDIX I: CERAMIC RECOVERIES 371

APPENDIX II: CERAMIC ATTRIBUTES 377

APPENDIX III: CERAMIC DATA 381

APPENDIX IV: LITHIC CODING FORMAT 392

APPENDIX V: LITHIC DATA 398

APPENDIX VI: SEDIMENTOLOGICAL METHODOLOGY 407

APPENDIX VII: SELECTED WALL PROFILES 433

ACKNOWLEDGMENTS

The magnitude of the Stott Site -- both in terms of physical size and number of investigations -- makes the involvement of many agencies and private individuals a critical factor in the successful completion of any project at the site. Certainly the most recent operations, major excavations in the summer of 1982 and salvage activities in the fall of 1983, owe their success to the co-operation and helpfulness of the following organizations and individuals, to whom I would like to publicly express my thanks.

-- At the Brandon District Office of the Department of Highways and Transportation, Sean Kavanagh, District Engineer, Elton Hayward, Assistant District Manager, Ken Tosh, 1982 Project Manager, Bill Sawiak, 1983 Project Manager, and Cliff Cowan, 1983 Field Supervisor, were consistently helpful and co-operative with us as we attempted to remove as much cultural material as possible before construction activities began.

-- During the 1982 field season, the crew lived and worked in Grand Valley Provincial Recreation Park. Use of these facilities was arranged by Larry Teetaert, Natural Resources Officer in the Carberry District of the Parks Branch of the Department of Natural Resources. In the park itself, we were aided by Roger Bosnick, Assistant Works Supervisor, and Park Foreman, Terry Blair, who provided us with such necessities of life as garbage cans and picnic tables, as well as luxuries like a back hoe for filling in some of the excavation units in Area Upper B.

-- Funding for field personnel in both years was provided by the Employment Development and Youth Services Branch of the Department of Labour and Employment Services through its Student Temporary Employment Programme (STEP).

-- Erik Nielsen and Heather Groom of the Geological Services Branch of the Department of Energy and Mines visited the site and discussed geological/geomorphological concerns with us. Professor James Richtik, Head of the Geography Department of the University of Winnipeg, made laboratory facilities available to us for soils analysis, while Kim Monson-Bell, Laboratory Supervisor, provided space, materials, advice and encouragement. Bob Newbury and Greg McCullough of the Freshwater Institute provided many valuable insights into the hydrology of the Assiniboine River and its effect on the surrounding landscape.

-- Professor C.T. Shay of the University of Manitoba and Professor B.A. Nicholson of Brandon University both assisted in various aspects of the lithic studies. Dr. Shay was always willing to discuss problems involving computer assisted analyses and Professor Nicholson lent us lithic samples, previous years' field notes and artifacts, as well as a quiet, dry place to read.

-- Jack Dubois, Assistant Curator of Mammals at the Manitoba Museum of Man and Nature, lent us skeletons for faunal identifications and provided ready access to the Museum's reference collection.

-- Dr. Leigh Syms, Curator of Archaeology at the Manitoba Museum of Man and Nature, provided unpublished materials on the Brockinton Site and access to the artifacts from that site for comparative purposes.

To some extent, the quality of any archaeological report depends upon the quality of data obtained in the field. That responsibility rests primarily with the excavation crew and certainly the 1982 project was fortunate in being able to utilize the skills of the following six students:

-- Barbara Eros and Marian Mustapha, University of Winnipeg; Gail Fifik, Kelly Land, Avis Mysyk and Mike Zywina, University of Manitoba. Additional personnel during the 1982 field season consisted of Steve Zoltai, soils analyst, and Sheila Bradford, who supervised the laboratory, excavated a unit, compiled the lithic reference collection and designed the lithic analysis. At the close of the field season, we were joined by Linda Roberts who analyzed the faunal recoveries. Although field operations were minimal in 1983, the aid of student assistant Barbara Eros and Peter Walker of the Historic Resources Branch was greatly appreciated.

Publication of this report has also involved the combined efforts of the Historic Resources Branch support staff:

-- Gary Dickson, who supervised the field and laboratory portions of the project and read an initial draft of the manuscript;

-- Peter Walker, who ably shepherded the manuscript through to its printing;

-- Peter Potschien, who did the studio photographs of the artifacts;

-- Dan Fedoruk, who drafted all the figures; and
-- Joan Wachs, who typed the manuscript.

Finally, I would like to express my appreciation to the family of Frank Stott and particularly to Mr. and Mrs. Glen Stott, who now farm on the site. Throughout the years, this family has expressed a vital interest and concern for the province's heritage resources as manifested in the prehistoric burial mound and camp sites located on their farm. Surely this concern has resulted in countless inconveniences for them, as archaeological crews have periodically descended upon the farm and taken possession of the valley wall for weeks at a time. Despite all the bother, they have accepted us with graciousness and good will. We appreciate their kindness and dedicate this volume to them.

P.M.B.

December 1983

LIST OF FIGURES

PAGE

1. Location of the Stott Site 2

2. The Area of the Stott Site 4

3. The Area of the Stott Site in 1880 6

4. View Across the Assiniboine River Valley from Area G 7

5. The Stott Site Area in 1947 8

6. The Stott Site Area in 1980 9

7. Proposed Construction Plans - Spring 1982 15

8. Excavation Units, Strat Pits and Test Pits in Area F 18

9. Excavation Units in Area Upper B 20

10. Opening the "Trench" Units on the Farm Side 21

11. Topographic Map of the Stott Site Area 26

12. Valley Top on the Farm Side of the Site 32

13. Cross Section of the North Wall of the Assiniboine Valley . . . 33

14. Dissected Terrain 36

15. Erosion on the Valley Wall 37

16. Mass Movement Scar on the Upper Portion of the Valley Wall . . . 38

17. Bowed Tree 39

18. Depositional Units and Soil Horizons Occurring in Strat Unit 4 . 45

19. Depositional Units in the Terrace Scarp Strat Units 5, 6 and 7 . 50

20. Horizon Pattern of the Orthic Regosols in the Terrace Scarp Strat Units 5, 6 and 7 51

21. Depositional Units and Soil Characteristics in Lower Terrace Scarp Unit 104 55

22. Depositional Units, Texture and Soil Horizons Occurring in Terrace Back Unit 99 63

PAGE

23. Sequence of Buried Paleosols at the Base of the Scarp 64
24. Depositional Units, Texture and Soil Horizons Occurring in Mid-Terrace Unit 125 67
25. Soil Horizons, Depositional Materials and Geomorphic Processes for Terrace Back Units 68
26. Soil Horizons, Depositional Materials and Geomorphic Processes for the Mid-Terrace Unit 69
27. Correlation of Mid-Terrace and Terrace Back Units 70
28. Buried Tree Stump in Unit 52N 25W 82
29. Infilled Gully 85
30. Landscape Evolution and Soil Relationships in Excavation Units 105-110 88
31. Depositional Units, Texture and Soil Horizons Occurring in Unit 108 89
32. Depositional Units, Texture and Soil Horizons Occurring in Unit 105 90
33. Depositional Units, Texture and Soil Horizons Occurring in Unit 116 97
34. Depositional Units, Texture and Soil Horizons Occurring in Unit 121 105
35. Depositional Units, Texture and Soil Horizons Occurring in Unit 119 106
36. Chernozemic Profile 107
37. Sequence of Buried Paleosols 108
38. Distribution of Male and Female Bison Phalanges 121
39. Lateral Cut Marks to the Bison Crania, Mandible, Ribs and Vertebrae 122

PAGE

40. Cut Marks to the Bison Front Leg 124
41. Cut Marks to the Bison Hind Leg 126
42. Proportional Recovery of Bison Elements 134
43. Comparison of Proportional Recovery Rates 136
44. Analysis of Ceramics from Units 99, 100 and 101 144
45. Ceramic Sherds and Vessels from Area F 145
46. Ceramic Sherds and Vessels from Area Upper B 149
47. Blackduck Ceramic Modes I, II and Variants 151
48. Blackduck Ceramic Modes III, IV, V, VI, VII, VIII, IX, X and Variants 152
49. Blackduck Vessels from Area Upper B 157
50. Blackduck Vessels from Area F 159
51. Blackduck Vessels from Area F 161
52. Distribution of Ceramic Modes in Area Upper B 162
53. Distribution of Ceramic Modes in Area F 163
54. Unclassified Vessels from Area F 189
55. BAAR Project Unclassified Vessels from Area F 193
56. BAAR Project Unclassified Vessels from Area F 197
57. Unclassified Vessels From Areas A and Upper B 199
58. Unclassified Vessels From Area Lower B 203
59. Kitchen and Laboratory Tents 206
60. Lithic Debitage and Tools from Area F 209
61. Lithic Debitage and Tools from Area Upper B 210
62. Lithic Tools from Area Upper B 221
63. Rough Unifaces from Area F 223
64. Rough Bifaces from Area F 225
65. Utilized Flakes from Area F 227

PAGE

66. Fine Unifaces from Area F 229

67. Fine Bifaces from Area F 231

68. Projectile Points from Area Upper B 233

69. Projectile Points from Area F 235

70. Projectile Points from Area A 251

71. Projectile Points from Area Upper B 253

72. Projectile Points from Area Lower B 255

73. Bone Tools from Area F 260

74. Bone Tools from Area Upper B 261

75. Awl-Like Bone Artifacts 267

76. Spatulate Bone Artifacts 269

77. Bone Artifacts 271

78. Fleshing and Butchering Tools 273

79. Top of the Bone Bed in Units 99 and 100 at 25 cm DBS 276

80. Bone Bed in Unit 118 at 40 cm DBS 277

81. Buried Soil Horizons in Unit 99 283

82. Layer of Decayed Bone on North Wall of Unit 99 285

83. Unit 125 -- Floor of Level 6 at 40 cm DBS 287

84. Feature 1 in Unit 102 on Level 9 292

85. Feature 2 in Unit 102 on Level 6 293

86. Diagram of Feature 2 297

87. Evidence of Vertical Bone Feature in Unit 117 303

88. Running the Chute 311

89. Hypothesized Location of Bison Drive Line and Pound 316

90. Location of Archaeological Components at DlMa-1 331

91. Eroding Embankment on West Side of TransCanada Highway 352

PAGE

92. Embankment Stabilization on the TransCanada Highway: Stott Site Impact Area 353

93. Earth Moving Equipment at the Site 355

94. Embankment Stabilization on the TransCanada Highway: Effect on the Stott Site 356

95. Senior Author Collecting Artifacts During Construction 358

96. Artifacts Recovered from Construction Area in 1983 361

97. Sample Data Sheet 413

98. Grain Size Distribution of Lacustrine Sediments 415

99. Grain Size Distribution of Unmodified Till 416

100. Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 2 - 12 cm DBS 417

101. Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 24 - 35 cm DBS 418

102. Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 47 - 60 cm DBS 419

103. Cumulative Frequency Curves of Grain Size Distribution of Lacustrine Sediments and Unmodified Till in Strat Unit 4 . . . 422

104. Cumulative Frequency Curve of Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 6 - 12 cm DBS 425

105. Cumulative Frequency Curve of Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 24 - 35 cm DBS . . . 426

106. Cumulative Frequency Curve of Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 6, 40 - 67 cm DBS . . . 427

107. Cumulative Frequency Curve of Grain Size Distribution of Lacustrine Enriched Till - Strat Unit 7, 22 - 33 cm DBS . . . 429

PAGE

108. Cumulative Frequency Curves in Unit 0N 104E 431

109. Unit 102 - 1S 125E, East Wall 434

110. Unit 103 - 0N 125E, North Wall 435

111. Unit 99 - 0N 104E, North Wall 436

112. Unit 99 - 0N 104E, West Wall 437

113. Unit 125 - 8S 93E, North Wall 438

114. Unit 125 - 8S 93E, West Wall 439

115. Unit 109 - 53N 25W, West Wall 440

116. Unit 108 - 52N 25W, West Wall 441

117. Unit 105 - 54N 24W, West Wall 442

118. Unit 110 - 54N 25W, West Wall 443

119. Unit 116 - 4S 40W, North Wall 444

120. Unit 114 - 6S 40W, North Wall 445

121. Unit 121 - 46S 27W, North Wall 446

122. Unit 119 - 46S 25W, North Wall 447

LIST OF TABLES

PAGE

1. Total Fauna by Number of Pieces per Unit 110
2. Total Fauna by Grams per Unit 111
3. Bones with Cut Marks 112
4. Stott Site Faunal Summary 113
5. Distribution of Major Bison Skeletal Elements 116
6. Ages of Stott Bison 119
7. Proportional Recovery of Bison Elements 133
8. Comparison of Faunal Recovery Rates 135
9. Size Categories and MNI of Canids 137
10. Animal Summary by Count and MNI 138
11. Area F Ceramic Summary 143
12. Area F Vessel Tally 146
13. Area Upper B Ceramic Summary 147
14. Area Upper B Vessel Tally 148
15. Area Upper B Vessels and Their Modes 154
16. Area F Vessels and Their Modes 155
17. Distribution of Ceramic Modes in Area Upper B and Area F . . 164
18. Radiocarbon Dates from the Smith Site 166
19. Undecorated Bodysherds - Area F 169
20. Undecorated Bodysherds - Area Upper B 170
21. Comparison of Smith and Stott Sites Blackduck Ceramic Rimsherd Attributes 171
22. Comparison of Smith and Stott Sites Blackduck Decorated Bodysherd Attributes 177
23. Smith Site Blackduck Clusters 181

PAGE

24. Comparison of Stott and Smith Sites Blackduck Types - Area Upper B 183

25. Comparison of Stott and Smith Sites Blackduck Types - Area F 184

26. Horizontal Distribution of Blackduck Cluster Vessels 185

27. Distribution of Ceramic Groups at DlMa-1 204

28. Ceramic and Lithic Recoveries in 1982 207

29. 1982 Lithic Debitage 208

30. Distribution of Lithic Artifact Classes by Area 213

31. Distribution of Lithic Tools by Unit in Area Upper B 214

32. Distribution of Lithic Tools by Unit in Area F 215

33. Metric Attributes of Rough Unifaces 217

34. Metric Attributes of Rough Bifaces 217

35. Metric Attributes of Utilized Flakes 218

36. Metric Attributes of Fine Unifaces 218

37. Metric Attributes of Fine Bifaces 219

38. Metric Attributes of Projectile Points 219

39. Distribution of Raw Materials for All Lithic Tools by Excavation Area 236

40. Distribution of Raw Materials by Artifact Class in Area Upper B 238

41. Distribution of Raw Materials by Artifact Class in Area F . 239

42. Popularity of Lithic Raw Materials in Area Upper B 241

43. Popularity of Lithic Raw Materials in Area F 242

44. Percentage Distribution of Lithic Raw Materials by Area . . 243

45. Projectile Point Typology and Chronology for Areas F and G . 245

PAGE

46. 1982 Projectile Point Typology for Area F 247

47. Distribution of Point Types from the Farm Portion of DlMa-1 248

48. Distribution of Point Types from the Park Portion of DlMa-1 249

49. Distribution of Point Types by Area at DlMa-1 258

50. Distribution of Bone Tools by Area 259

51. Bone Artifacts Recovered in 1982 263

52. Location of the Bone Bed 279

53. Distribution of Bone and Lithic Debitage in Unit 125 286

54. Hearth Features at DlMa-1. 290

55. Cultural Sequence at the Avery Site 305

56. Stott Site Radiocarbon Dates 327

57. Archaeological Components at the Stott Site in Dated Contexts 328

58. Comparison of Recoveries in Areas F and Upper B 337

59. Prevailing Wind Direction in the Brandon Area 338

60. Stott Mound Burials. 343

61. Plan for Multiple Pipette Analyses 412

INTRODUCTION

> My family had now been increased by the addition of a poor old Ojibbeway woman and two children, who being destitute of any men, had been taken up by Net-no-kwa. Notwithstanding this, I thought it still best for us to live by ourselves. I hunted with considerable success and remained by myself until the end of the season for making sugar [Spring 1802], when Net-no-kwa determined to return to Menaukonoskeeg, while I should go to the trading house at Red River to purchase some necessary articles. I made a pack of beaver and started by myself in a small buffalo skin canoe, only large enough to carry me and my pack, and descended the Little Saskawjewun.
>
> ... Accordingly I went to the top of the hill, where I discovered tracks and other signs, and following a little distance, found a horse which I knew belonged to the trader I was going to see. As several miles travel might be saved by crossing from this point on the Little Saskawjewun to the Assinneboin, I left the canoe, and having caught the horse, and put my load upon him, led him towards the trading house where I arrived next day. ...
>
> After I returned from trading at the Red River, I went to live at Naowawgunwudju, the hill of the buffalo chase, near the Saskawjewun. This is a high rocky hill, where mines may probably be found, as there are in the rocks many singular looking masses. Here we found sugar trees in plenty, and a good place for passing the spring. Game was so abundant, and the situation so desirable, that I concluded to remain instead of going with all the Indians to Clear Water Lake [Riding Mountain]. ... (Tanner in James 1956:91; 93-94).

An exact determination of the location of John Tanner's "hill of the buffalo chase" is not possible, of course, but from his general description of the area, on a hill near the confluence of the Little Saskatchewan River with the Assiniboine River, he might well be referring to that area known today as DlMa-1, or the Stott Site. Located 8 km west of Brandon and 2 km downstream from the union of the Little Saskatchewan with the Assiniboine on the southeast facing slopes of the Assiniboine valley wall (Figure 1), the Stott

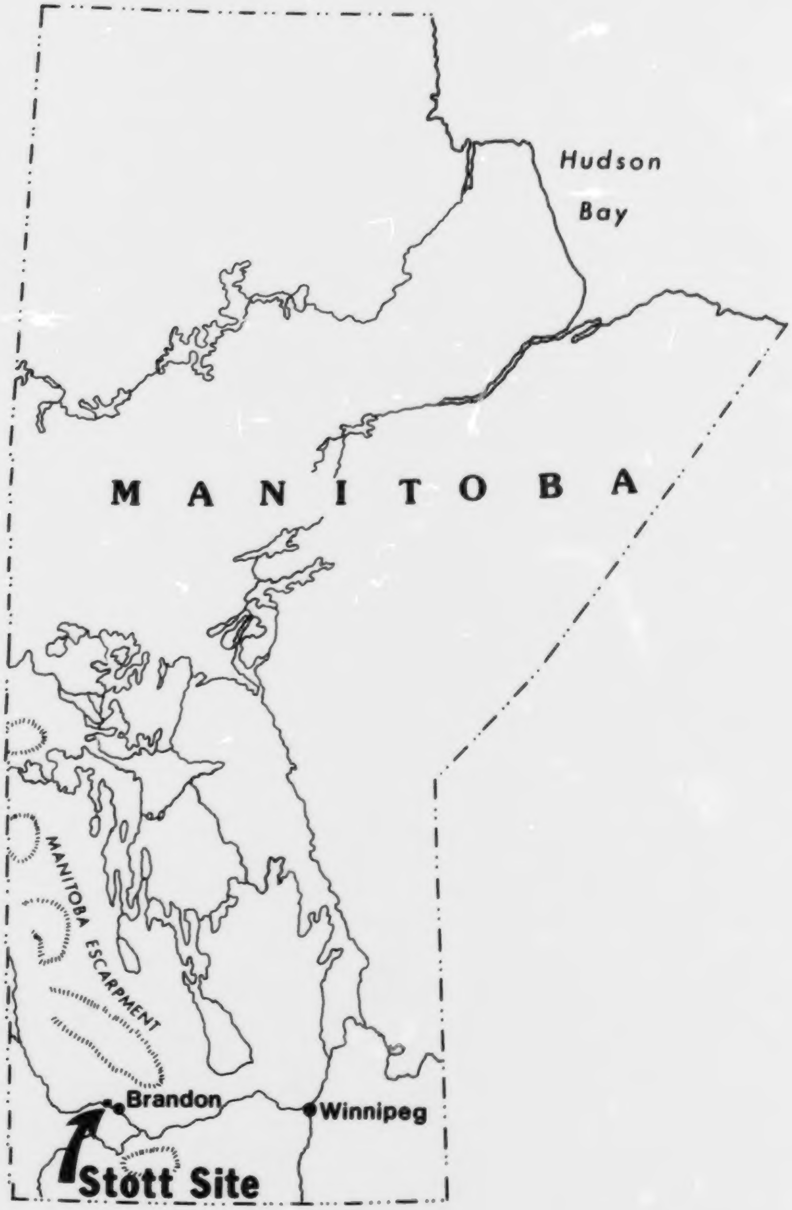

Hudson
Bay
MANITOBA
MANITOBA ESCARPMENT
Brandon
Winnipeg
Stott Site

Figure 1. Location of the Stott Site.

Site has been of archaeological interest since 1945 when property owner, Frank Stott, first visited Dr. Ralph D. Bird at the Dominion Entomological Laboratory in Brandon to ask advice concerning the large quantity of bison bone recovered during his excavation of a cellar and the supposed burial mound located above the valley wall on the prairie level (Bird 1947:2).

Since that time, a series of archaeological excavations (Bird 1947; MacNeish 1954; Saylor 1976; Watrall 1976; Tisdale 1978; Syms et al. 1979; Hamilton 1981; and Pokotylo and Tisdale 1982) spanning nearly 40 years have investigated the burial mound as well as various small terraces on the valley wall below and east of the mound (Figure 2). Ceramic recoveries have been classified primarily as Blackduck; lithic tools seem overwhelmingly affiliated with the late Prairie and/or Plains side-notched projectile point typologies. In general terms, the site has been characterized as a Late or Terminal Woodland camp where bison were butchered in sufficient quantities to produce a bone bed at least 25 cm thick in some locations. Interpretation of these remains have ranged from that of an Assiniboine village (MacNeish 1954:50) to "a series of residential occupations by Blackduck people who were specialized bison hunters" (Hamilton 1981:14). It has been assumed, since MacNeish's excavation of the mound in 1952, that the cultural materials recovered on the valley wall were left by the builders of the mound, or conversely, the relationship between the mound and the camp areas has been ignored.

No doubt the very size of the site has contributed to the lack of precision involved in determining its boundaries. That part of DlMa-1 designated by the province as an Historic Site falls within the SW 1/4 of Section 35, Township 10, Range 20 West, owned presently by the Stott family and the Crown. The first survey in Township 10 was conducted in the fall of

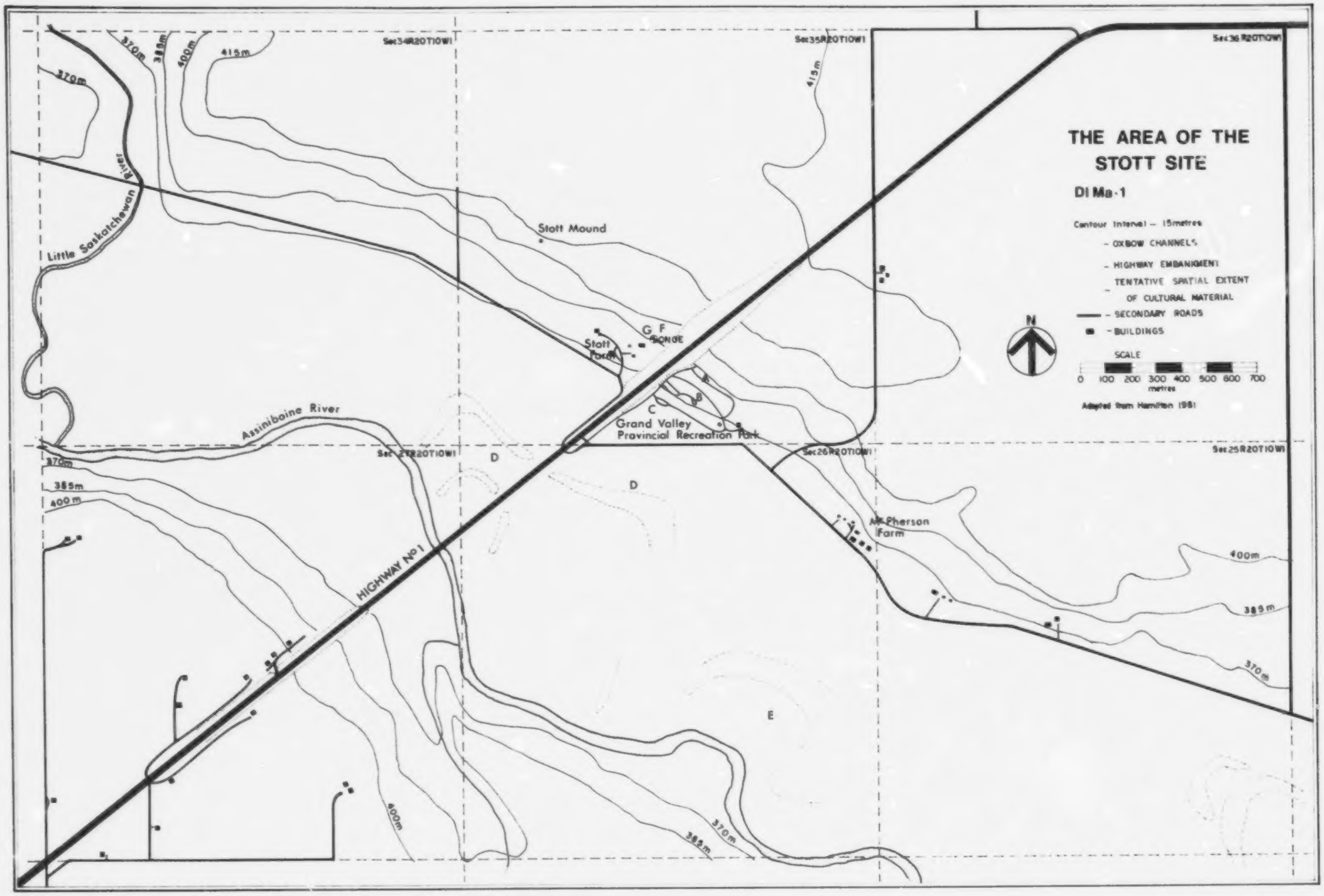

THE AREA OF THE STOTT SITE
DI Ma-1
Contour Interval – 15metres
– OXBOW CHANNELS
– HIGHWAY EMBANKMENT
– TENTATIVE SPATIAL EXTENT OF CULTURAL MATERIAL
– SECONDARY ROADS
– BUILDINGS
N
SCALE
0 100 200 300 400 500 600 700
metres
Adapted from Hamilton 1981
Sec34R20T10W1
Sec35R20T10W1
Sec36R20T10W1
Sec27R20T10W1
Sec26R20T10W1
Sec25R20T10W1
370m
385m
400m
415m
Little Saskatchewan River
Assiniboine River
Stott Mound
Stott Farm
G F
SONDE
B
C
D
E
Grand Valley Provincial Recreation Park
McPherson Farm
HIGHWAY No1

Figure 2. The area of the Stott Site.

1880 by G.B. Abrey, prior to construction of the Canadian Pacific Railroad. At that time William Postlethwaite held title to the south half of Section 35, while the south half of Section 34, containing the junction of the Little Saskatchewan and Assiniboine Rivers, was owned by Norman and Dan McMillan (Figure 3). This particular stretch of terrain does not seem to have been remarkable in any way, other than perhaps the magnificent view it commanded of the Assiniboine valley (Figure 4). The rivers, of course, functioned as the main transportation routes, especially in pre-horse times (see Tanner in James 1956:1). The trail to Fort Ellice ran south of the Assiniboine River at this point, crossing Sections 7, 8, 9, 10, 11 and 12. No other land trails were located nearby, although as a boy, Frank Stott remembers seeing Indians camped along the northwestern edge of the valley on his family's farm land (Bird 1947:1).

When Ralph Bird and Chris Vickers conducted the first test excavations at DlMa-1 in July, 1947, the site was virtually untouched (Figure 5). The mound remained undisturbed and the valley wall itself was not utilized for much other than the grazing of cattle. In the mid-1950s, however, construction of the TransCanada Highway saw the creation of a bypass around Brandon, which bisected the valley wall where it contains DlMa-1. At that time the full extent of the site was not known, although both Frank Stott and A.M. MacPherson, who farmed in Section 26-10-20 West, possessed large collections of artifacts which they had gathered from their fields on the prairie level, the valley wall and the flood plain adjacent to the Assiniboine River. In 1960, Stott property east of the TransCanada Highway was purchased by the province in order to create a small park and campground. It proved so popular that a major expansion of facilities was begun in 1964 (Figure 6) and

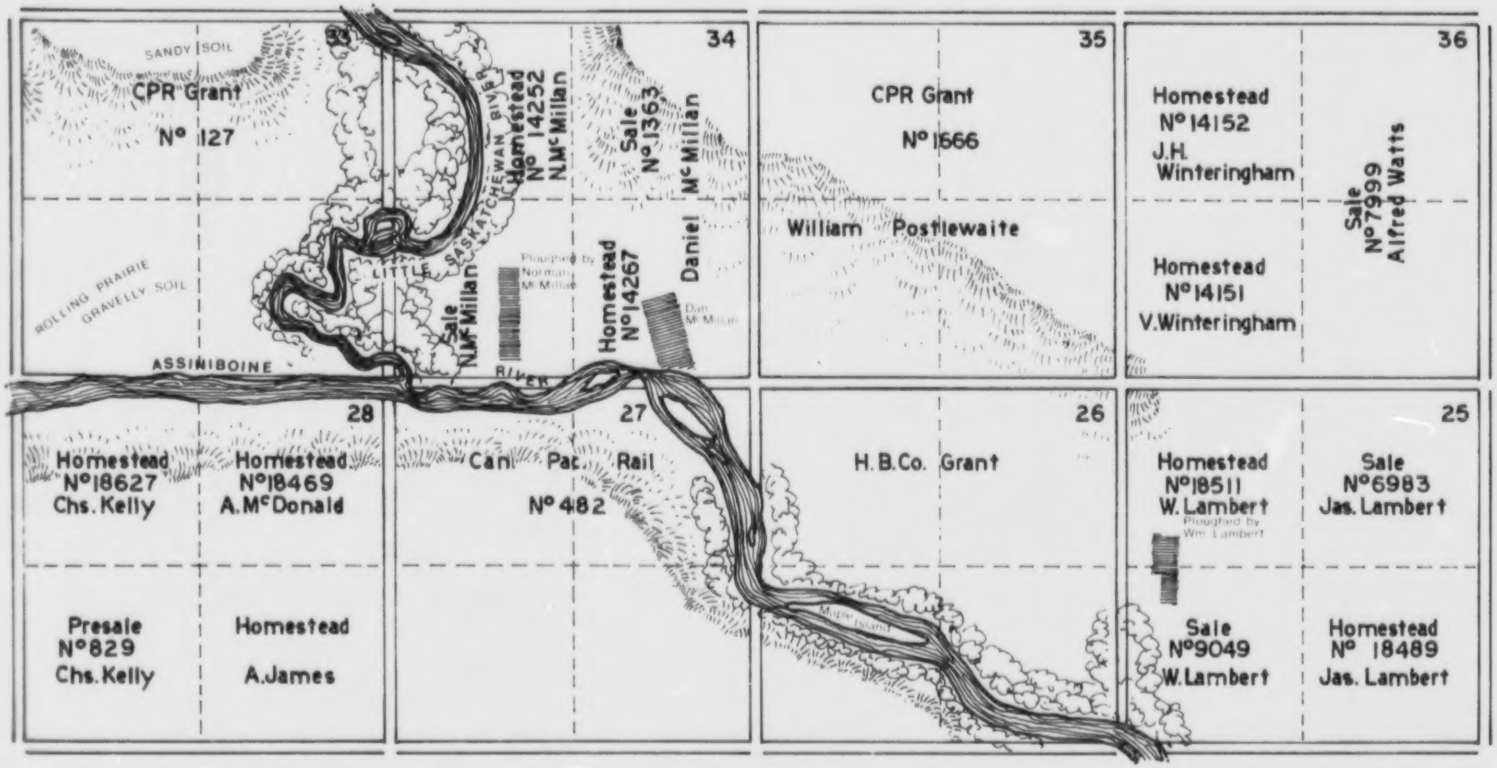

33
34
35
36
28
27
26
25
SANDY SOIL
CPR Grant
Nº 127
ROLLING PRAIRIE
GRAVELLY SOIL
ASSINIBOINE
RIVER
LITTLE SASKATCHEWAN RIVER
Sale
N.McMillan
Ploughed by Norman McMillan
Homestead
Nº 14252
N.McMillan
Sale
Nº1363
Daniel McMillan
Homestead
Nº14267
Dan McMillan
CPR Grant
Nº 1566
William Postlewaite
Homestead
Nº14152
J.H. Winteringham
Homestead
Nº14151
V.Winteringham
Sale
Nº7999
Alfred Watts
Homestead
Nº18627
Chs. Kelly
Homestead
Nº18469
A.McDonald
Presale
Nº829
Chs. Kelly
Homestead
A.James
Can. Pac. Rail
Nº 482
H.B.Co. Grant
Maple Island
Homestead
Nº18511
W. Lambert
Ploughed by Wm Lambert
Sale
Nº6983
Jas. Lambert
Sale
Nº9049
W.Lambert
Homestead
Nº 18489
Jas. Lambert

Figure 3. The area of the Stott Site in 1880 (adapted from the Dominion Survey map of G.B.Abrey, 1881).

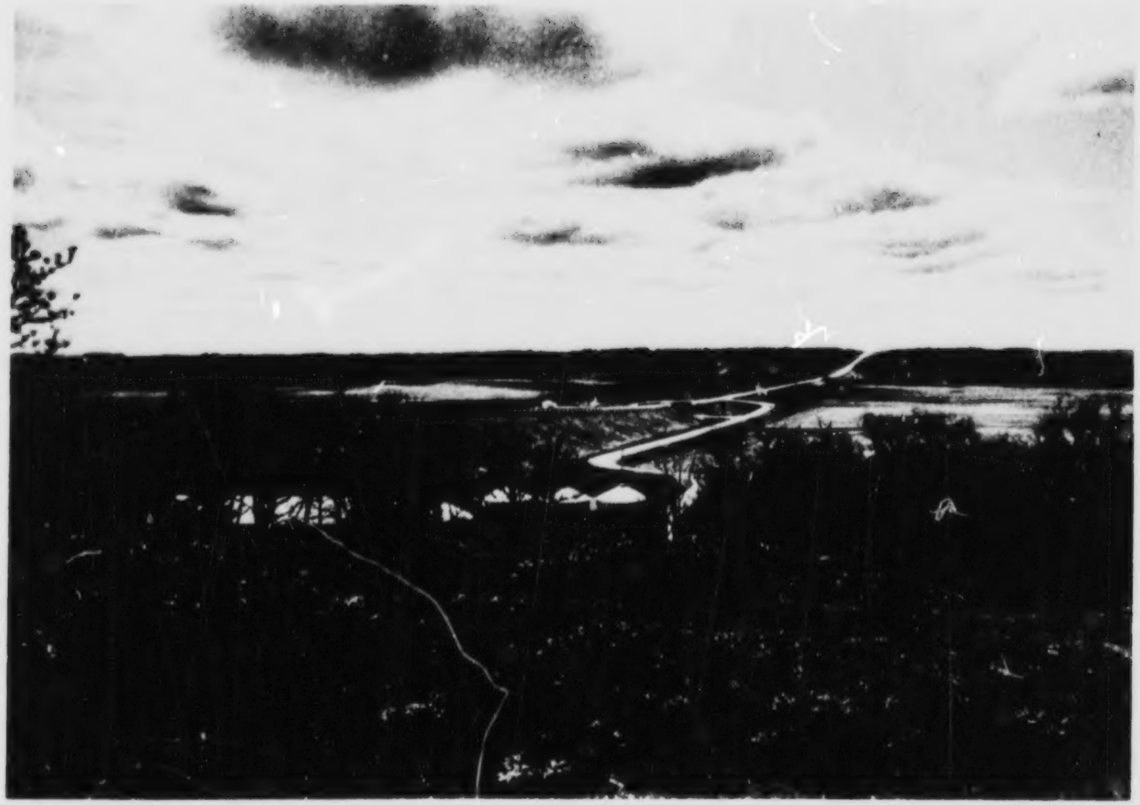


Figure 4. View across the Assiniboine River Valley from Area G

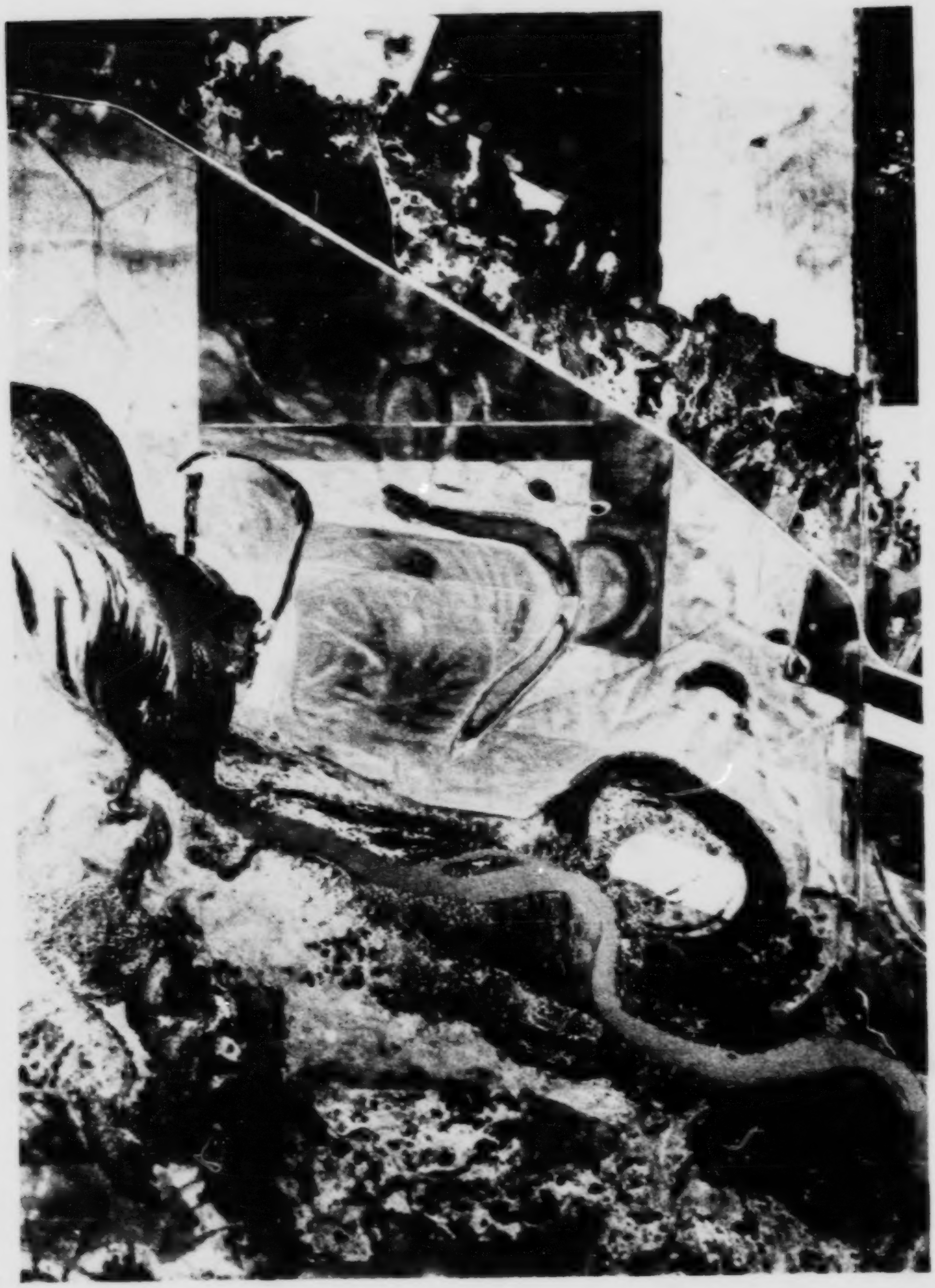


Figure 5. The Stott Site Area in 1947

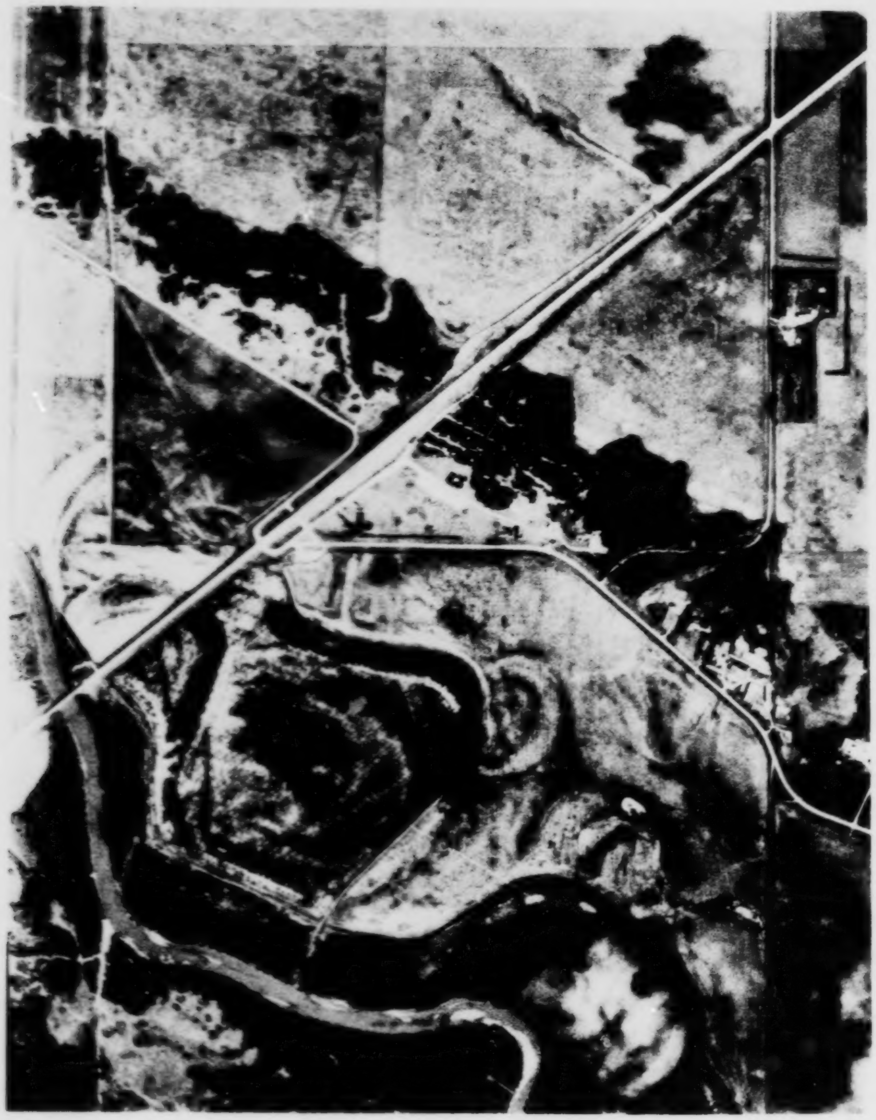


Figure 6. The Stott Site area in 1980.

completed a few years later (Willard Anderson, Planner, Parks Branch, Department of Natural Resources: Personal Communication). With the exception of the first two excavations of the site in 1947 and 1952 (Bird 1947; MacNeish 1954) and the Field Schools conducted in Area G in 1975 and 1976 (Saylor 1976; Watrall 1976), other work at DlMa-1 has been in response to the proposed widening of the TransCanada Highway to four lanes from the 18th Street exit at Brandon to the Assiniboine River bridge. Tisdale's survey of Grand Valley Provincial Recreation Park in 1977 satisfactorily demonstrated that DlMa-1 extended on both sides of the highway and that, obviously, a large portion of the site had been destroyed during its construction.

The following report contains in part an analysis of the cultural materials recovered from the Stott Site during the latest, 1982, excavations. For 15 weeks from May 17 - August 27, a crew of nine under the auspices of the Historic Resources Branch of the provincial Department of Culture, Heritage and Recreation camped in Grand Valley Provincial Recreation Park while excavating on the Stott farm and in the park itself. The main objective of the 1982 project, like that of all recent excavations, was to salvage as much material as possible from areas likely to be disturbed by future highway expansion. Although the primary goal of the present report is to describe as fully as time permits the materials recovered in 1982, additional efforts have been made to expand the analysis to include both cultural materials recovered in prior excavations, where appropriate, and an investigation into the history of soil formation at the site, as well as the mechanisms of erosion which have affected the deposition of cultural materials.

Although neither of these additions to the report can be considered comprehensive in scope, certainly they are necessary if a fuller knowledge of the Native peoples who utilized this portion of the Assiniboine River valley is to be achieved. With each successive excavation at DlMa-1, a new mass (literally) of artifacts has been recovered and analyzed. The time constraints which affect all projects scarcely permit analysis of the "new" artifacts; certainly an incorporation of, or comparison with materials excavated previously is impossible. Consequently, each researcher is faced with ever-expanding amounts of data from DlMa-1, usually retrieved from widely dispersed areas of the site, and certainly not integrated in terms of space or analysis.

Obviously the 1982 project has not been able to avoid these sorts of problems either, but a commitment from the outset to retrieving artifacts only if they could be cleaned, catalogued and analyzed helped to insure that adequate time was set aside to accomplish these tasks. In order to deal effectively with questions of soil deposition and erosion, placement of excavation units was made in consultation with the soils analyst. Most units were set in blocks, running either vertically or horizontally on the valley wall, so that large areas of contiguous wall profiles were revealed. Throughout the excavation and analysis, an emphasis was placed upon assessing the relationship of cultural materials recovered in 1982 to the accepted designation of DlMa-1 as a single component Blackduck campsite with associated burial mound.

The report of the 1982 excavations at the Stott Site is a joint effort of the three researchers listed as its authors. Steve Zoltai produced Chapter II, which contains sections on environmental, soils and stratigraphic concerns as they relate to the site and interpretations of its meaning. Linda Roberts was responsible for an analysis of all the faunal remains recovered, something in excess of 66,000 pieces of bone. The major portion of her work is located in Chapter III, but she also contributed an analysis of the bone tools, as well as the vertical bone contained within the V-shaped pit features (Chapter IV). The senior author was responsible for this introduction as well as the remaining sections, Chapters I, IV and V, dealing with research design and methodology, cultural recoveries and interpretations, respectively. The major factor contributing to the successful completion of the manuscript has been the frequent exchange of data, problems, ideas, etc. among the people involved. Continuing conversation kept us interested in each other's sections of the report, as well as our own.

CHAPTER I

FIELD STRATEGY

RESEARCH DESIGN

The 1982 excavations at DlMa-1 were designed to complement the salvage operations carried out in Grand Valley Provincial Recreation Park in 1981, which themselves were a response to the initial archaeological testing of the park in 1977. When proposals to expand the TransCanada Highway to four lanes west of Brandon were first circulated, the potential for severe damage to the Stott Site was immediately obvious. Tisdale's efforts in Grand Valley Provincial Recreation Park in 1977 and those of Hamilton's Highway Survey (1981) and the Brandon Field School (Syms et al. 1979) in Area F demonstrated the presence of significant archaeological materials in areas certain to be affected by any widening of the road bed.

Approval of the expansion plans necessitated further excavations at DlMa-1 in 1981. Although no construction details were available at the beginning of the field season, it was logically assumed that major activity would occur within the park to the east of the highway, because property to the west (the Stott farm) was privately owned and would have to be acquired; Grand Valley Provincial Recreation Park, of course, was already Crown land. To that end, the 1981 crew headed by Dr. David Pokotylo of the University of British Columbia re-examined Areas A and Upper and Lower B, which had been tested in 1977. The 1982 excavations, directed by the senior author of this report, were originally intended to further investigations in the park, emphasizing areas to be impacted by construction. Specifically, this should have involved salvaging as much information as possible from the western edge of the park in Area Upper B.

Acquisition of the Department of Highways and Transportation's construction plans, however (see Figure 7), revealed that, contrary to expectations, a portion of the Stott property comprising the eastern edge of Area F would be removed during operations to improve the grade of the slope at that locale and also to provide fill for construction of a new bridge over the Assiniboine River. Impact on the park, however, would be less than had been expected. At this point, shortly before the beginning of the field season, the Historic Resources Branch plans were amended to include the excavation of a small portion of Area F within the zone to be affected by construction activities on the Stott farm. It was hoped that an immediate demonstration on the part of the Historic Resources Branch of the magnitude of destruction that would occur to DlMa-1 if these construction plans were carried out, would be sufficient to convince the Department of Highways and Transportation to alter its plans. Following the initial work in Area F, the crew would return to the park and continue salvage operations in Area Upper B.[1]

Two general goals existed for the 1982 field season, then: 1) to demonstrate the magnitude of cultural materials at the eastern edge of Area F, and 2) to salvage as much data as possible from the threatened portion of Area Upper B. As adjuncts to these goals, more specific problems would also be considered:

1) a determination of the depositional history of the site, so that informed interpretations about the stratigraphic relationships of cultural materials could be made;

[1] This desired scenario has, in fact, actually occurred. Construction plans have been altered to minimize activity west of the TransCanada Highway. Additionally, the Historic Resources Branch will have "on-the-ground" approval rights for activities west of the Highway which might adversely affect the site. Area Upper B is considered to have been sampled sufficiently during 1977, 1981 and 1982, so that there are no objections to construction activities within that area of the park (see Addendum).

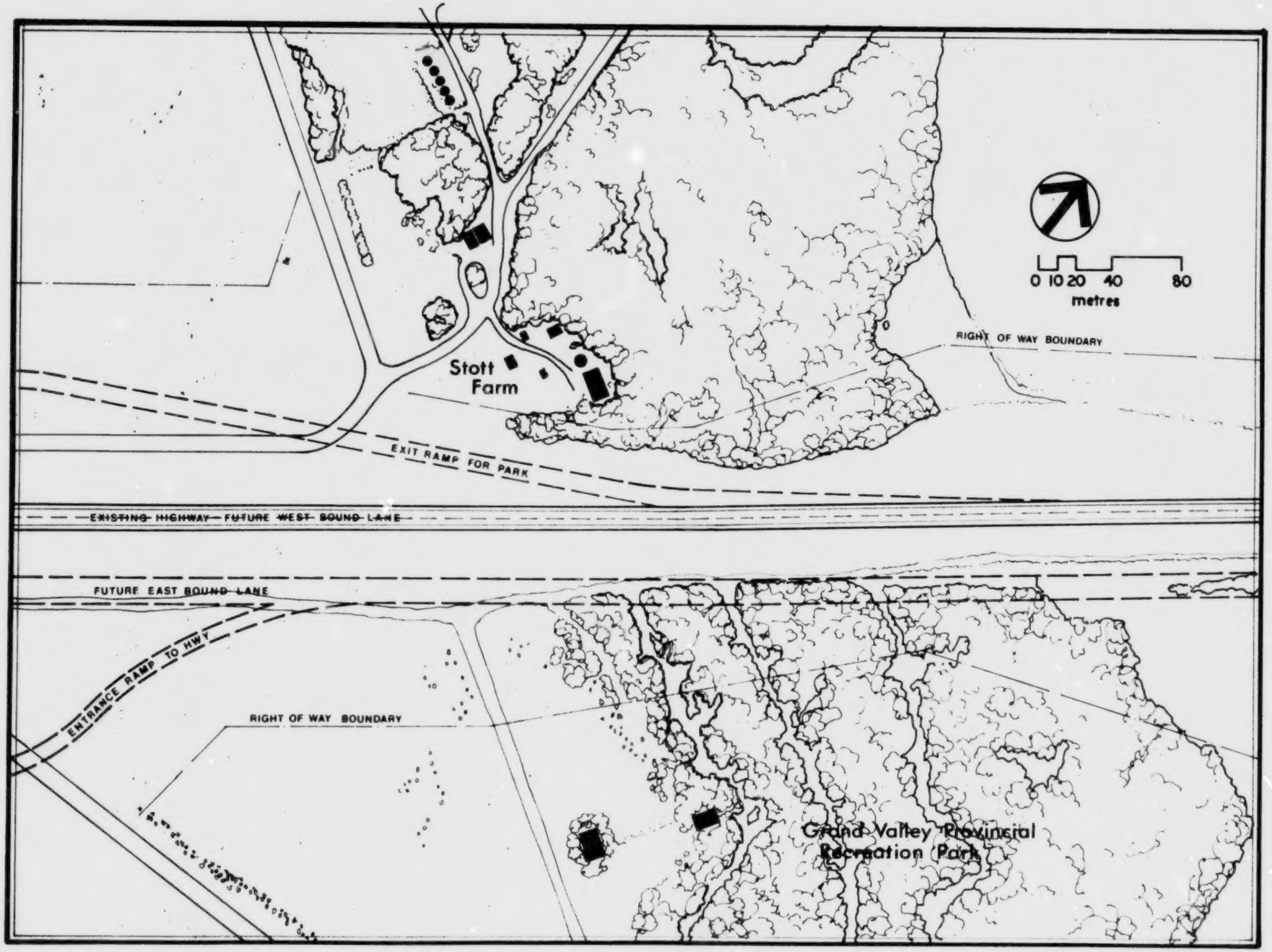

0 10 20 40 80
metres
RIGHT OF WAY BOUNDARY
Stott Farm
EXIT RAMP FOR PARK
~~EXISTING HIGHWAY~~ FUTURE ~~WEST BOUND LANE~~
FUTURE EAST BOUND LANE
ENTRANCE RAMP TO HWY
RIGHT OF WAY BOUNDARY
Grand Valley Provincial Recreation Park

Figure 7. Proposed construction plans - Spring, 1982.

2) a determination of what activities were carried out at the site and in its nearby surroundings;
3) a determination of the season(s) of the year in which activities were carried out at the site;
4) through ceramic and lithic analyses, as well as stratigraphic data, an investigation of the number of archaeological components present at the site;
5) a determination of the relationship of the farm to the park portion of the site; and
6) an investigation of the relationship of the cultural component(s) to the burial mound.

SURVEY AND MAPPING

The 1982 project at DlMa-1 was fortunate in being able to capitalize on the hard work that previous crews had put into the site. On both sides of the highway it was possible to co-ordinate the surveying of units with data from previous excavations. The site datum (0N 0E), located in Area G, had been made permanent in 1976 "with a stout metal pipe set in a concrete base" (Watrall 1976:26). Utilizing it, the 1979 Field School surveying notes and known elevations, an east-west baseline was established at 8N. From 8N 105E in Area F, points were measured in at 1N 105E and 0N 105E. With these co-ordinates established, three adjacent 1 x 1 m units were triangulated with datums set at the southeast corners -- 0N 104E, 0N 105E and 0N 106E. Later the 0N line was extended eastward and three more units placed at 0N 125E, 1S 125E and 2S 125E. The final unit excavated in Area F was established at 8S 93E. In addition, Strat Pit 1 was opened by Zoltai near the 1979 Field

School's Test Pit 6; its co-ordinates were measured as 6.5S 106.5E. Figure 8 gives the location of the excavation units, strat pits and test pits in Area F.

When Tisdale began to survey within Grand Valley Provincial Recreation Park in 1977, an immediate concern involved the impracticality of utilizing the site datum, which lay approximately 300 m west of the edge of the park with both the TransCanada Highway and a fair amount of irregular terrain intervening. Furthermore, not only was the park too distant from the site datum, within the park itself, individual areas were separated from each other by great distances, park structures, etc. Therefore, surveying from one datum point within the park to other locations within the park was also impractical. Consequently, each area tested in 1977 (A, Upper B, Lower B) was provided with its own datum. In turn, each of these area datum points was related to the central north-south baseline running through the park, which had been established during expansion of the park facilities in 1964. This baseline does not follow true north, however; in fact, it parallels the TransCanada Highway and is considered for mapping purposes to be "grid north". In 1981 the three area datum points were made permanent by setting metal pipes in concrete. As well, additional surveying tied Areas F and G into the park system (Pokotylo and Tisdale 1982). At least theoretically, it is now possible to compare cultural materials, regardless of their area of origin, in terms of their relationship to the site datum in Area G.

Using data from prior excavations in Area Upper B in 1982, an initial set of six 1 x 1 metre excavation units (105 - 110) was laid out in previously unexcavated terrain uphill from Camping Bay 23. After the excavation of these had been completed, another set of six 1 x 1 metre units (111 - 116) was positioned east of 1977 Units 35, 39 and 40. An additional two 1 x 1 metre

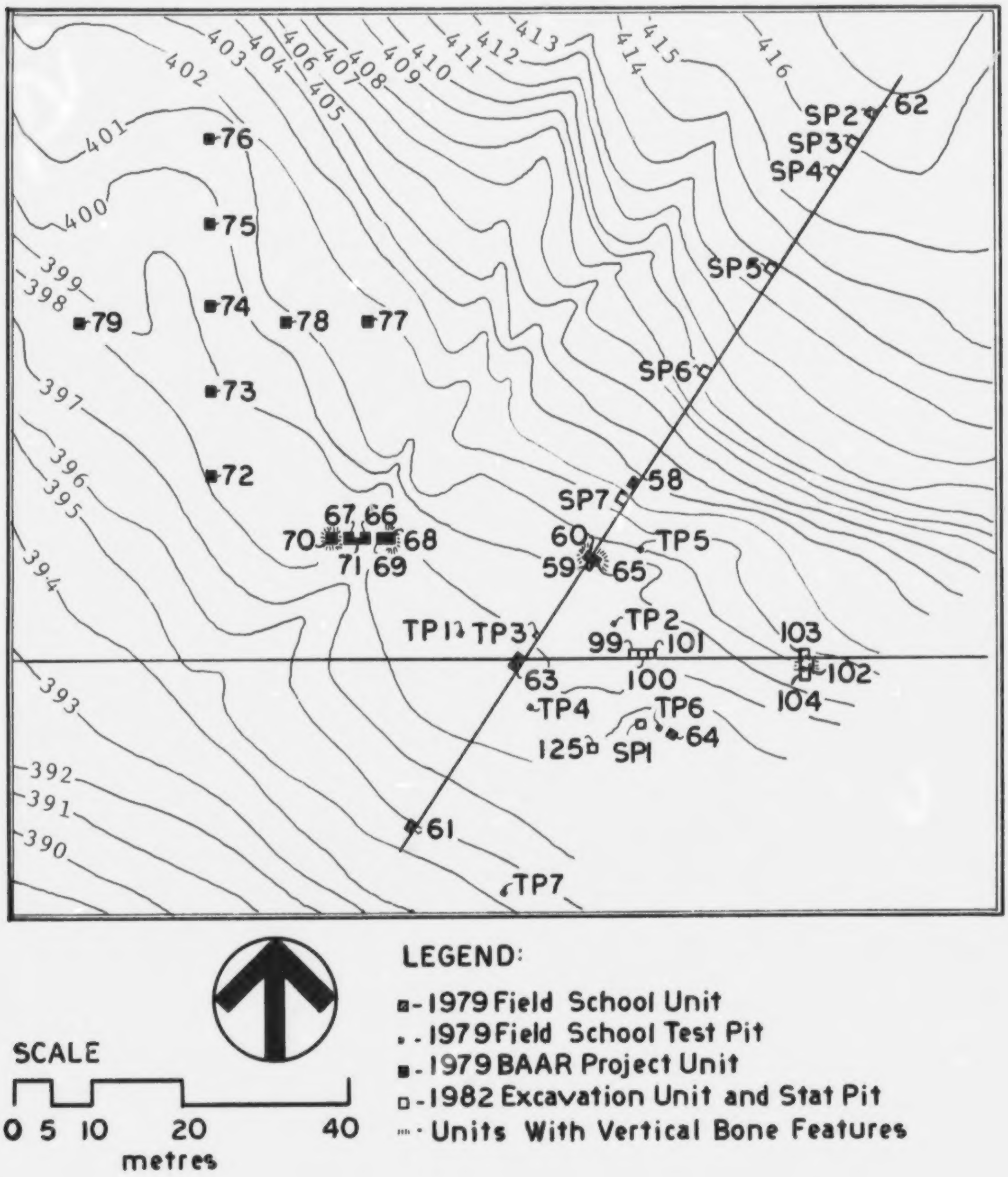

403
404
406
407
408
409
410
411
412
413
414
415
416
402
405
401
400
399
398
397
396
395
394
393
392
391
390
76
75
74
73
72
79
78
77
SP2
62
SP3
SP4
SP5
SP6
SP7
58
67
66
70
68
71
69
60
59
65
TP5
TP2
TP1
TP3
99
101
103
102
63
100
104
TP4
TP6
64
125
SP1
61
TP7
LEGEND:
- 1979 Field School Unit
- 1979 Field School Test Pit
- 1979 BAAR Project Unit
- 1982 Excavation Unit and Stat Pit
- Units With Vertical Bone Features
SCALE
0 5 10 20 40
metres

Figure 8. Excavation units, strat pits and test pits in area F.

units (117 and 118) were placed at the southern edge of the 1981 Unit 87 in order to obtain a wall profile that would be directly comparable between the two years. A final six 1 x 1 metre units (119 - 124) were placed in another unexcavated region north of Camping Bay 1. Figure 9 gives the location of the excavation units in Area Upper B.

Although all excavation units at the Stott Site have measured co-ordinate designations, in fact, an informal numbering system has been used throughout the years. Each unit is given a numerical designator in relation to the chronological order in which it was excavated. Consequently, the seven units excavated in Area F in 1982 are numbered 99 - 104 and 125. The 20 units from Area Upper B range from 105 - 124.

METHODOLOGY

The 1982 field crew at DlMa-1 consisted of nine persons: a director, a laboratory supervisor, a soils analyst and six excavators. In the initial three units excavated in Area F, commonly known as the "trench", the six excavators were grouped two to a unit in order to move as quickly as possible through the presumed deep and dense bed of bison bone. Also, by keeping the crew close together at the beginning of the field season, it was easier to insure that everyone understood instructions and procedures. Following completion of these first units, 99 - 101, each excavator worked individually for the rest of the season (see Figure 10).

The southeast corner of each unit was designated as the unit datum; its co-ordinates were those used to identify the unit officially. True elevation was measured at the datum corner and although the depth measurements of artifacts recovered were not calculated according to elevation, these

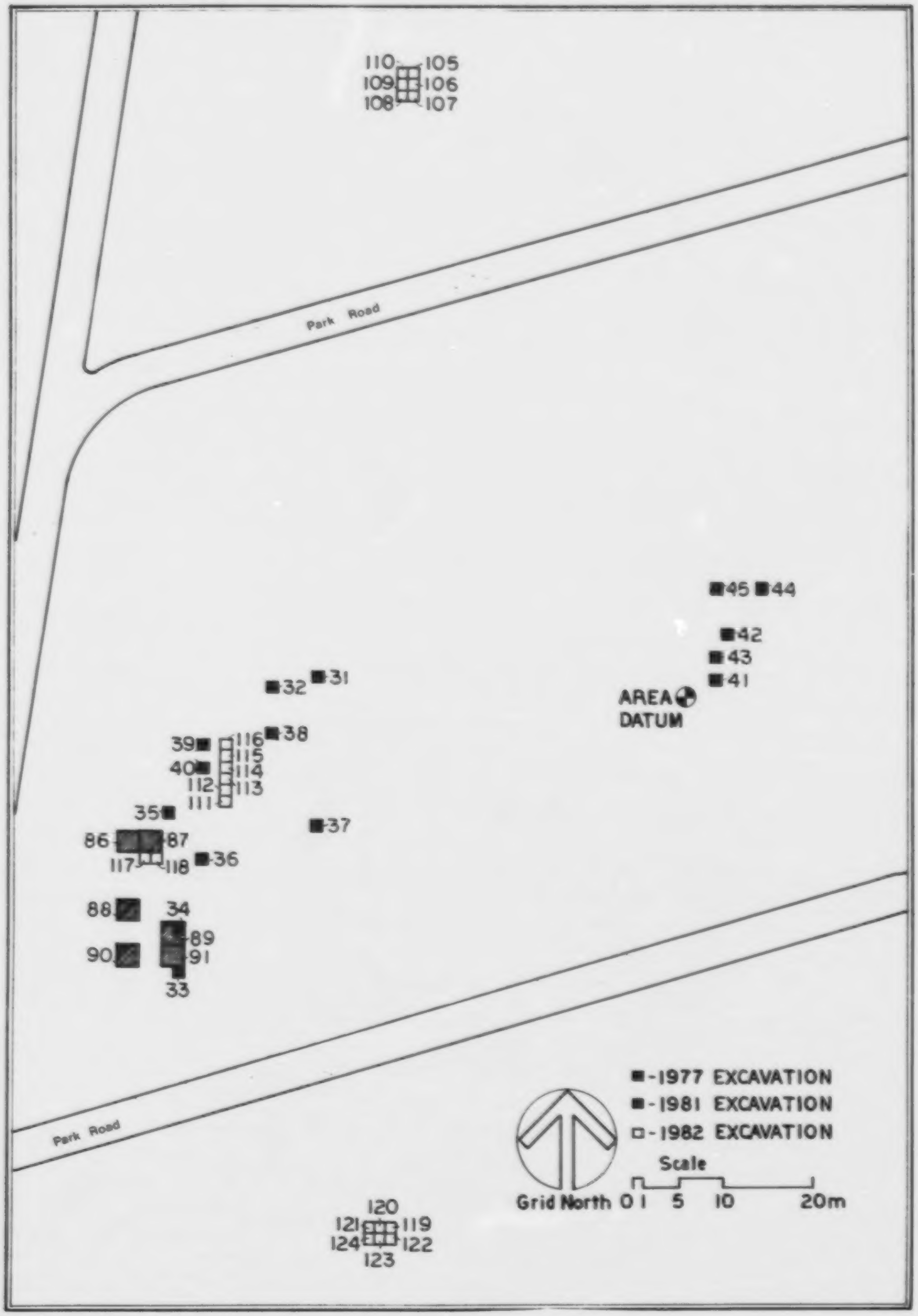

110
105
109
106
108
107
Park Road
45
44
42
43
41
AREA DATUM
32
31
39
116
38
40
115
114
112
113
111
35
37
86
87
117
118
36
88
34
89
90
91
33
Park Road
■-1977 EXCAVATION
■-1981 EXCAVATION
□-1982 EXCAVATION
Scale
0 1 5 10 20m
Grid North
120
121
119
124
122
123

Figure 9. Excavation units in Area Upper B.

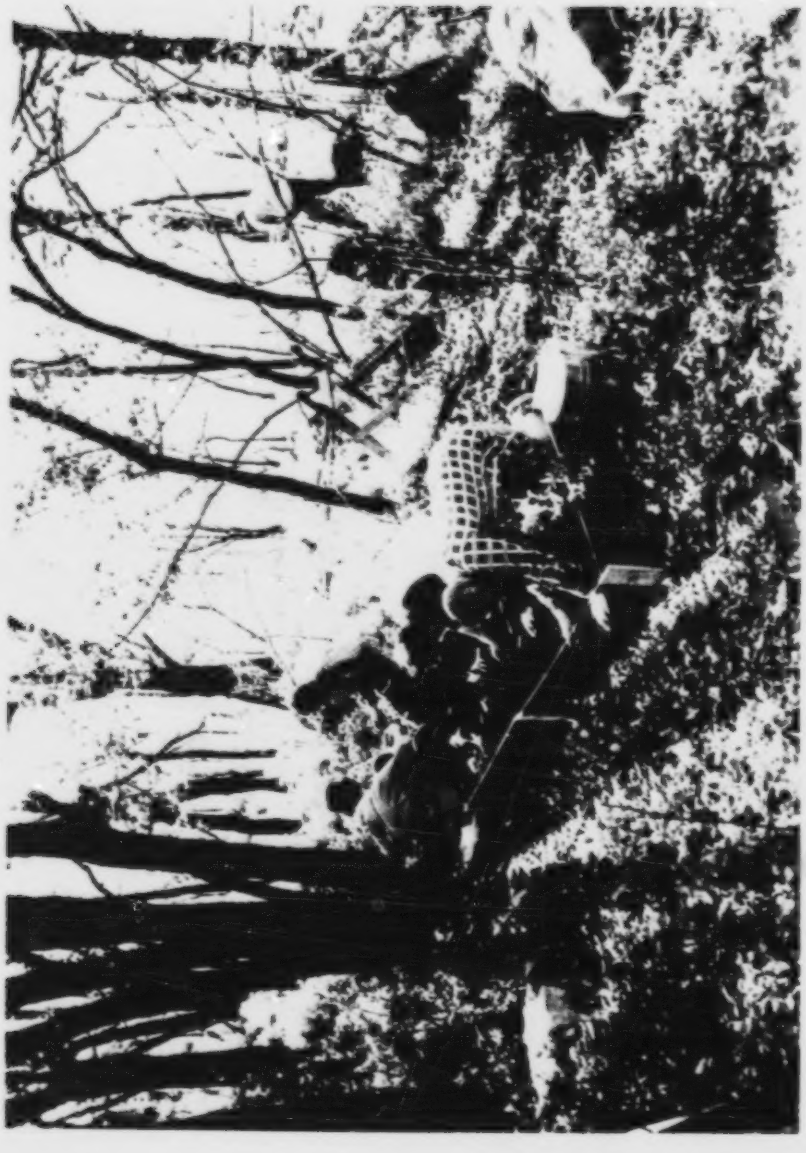


Figure 10. Opening the "trench" units on the farm side. Crew members - foreground: Marion Mustapha, Mike Zywina, Kelly Land, Barbara Eros. Background: Steve Zoltai opening Strat Pit 1.

figures can be obtained from existing data if future researchers find them useful. The first level of each unit was dug to a depth sufficient to insure that the floor was even. In most cases this was 5 cm, but occasionally 10 cm; Unit 125's first level, however, was 15 cm deep. Thereafter, each level was 5 cm in depth until nearly sterile soil was reached, when levels were expanded to 10 cm. Excavation was ordinarily accomplished with trowel, wisk and dust pan, although shovels were routinely utilized in the final few levels of a unit and, generally, at the discretion of the soils analyst. All soil was screened through 5 mm mesh.

Because the amount of cultural material recovered was expected to be large, it would be impossible to provenience precisely all items recovered from the excavations. Therefore, only the exact provenience (cm north and west of the unit datum; depth below surface measured from the bottom of the unit datum stake) of diagnostic materials was recorded. Diagnostic materials were defined to include all lithic items which evidenced signs of human modification or utilization; all items fashioned of Knife River Flint; all ceramic rim, neck or shoulder sherds, any ceramic sherd bearing decoration; and any faunal material deemed identifiable beyond the general mammal classification. All other materials were grouped by class per level, e.g., flakes from Level 2 or body sherds from Level 7, and not provenienced further. The major drawback to such a system, of course, involved both nonrecognition of diagnostic materials under field conditions and overestimation of the specific faunal identifications possible. Nevertheless, given the constraints of time, this system of proveniencing artifacts worked relatively well.

Upon completion of each unit, all walls were photographed in black and white, as well as colour. In addition, selected wall profiles were drawn for each unit by the soils analyst. Soil samples were also taken, as well as any potential samples of charcoal large enough to use for radiocarbon determinations.

In several instances, the 10 cm balks separating individual units were removed, usually to expose the wall profile more extensively. The two balks separating Units 99, 100 and 101 were removed in Area F. In Upper B, the balks between Units 107/108, 117/118, 119/120 and 119/122 were also taken down. In these instances, excavations were carried out in natural soil horizons, as identified by the soils analyst, in order to speed up completion of the units. Cultural materials recovered from the balks were provenienced by natural soil horizon designations, or in the case of diagnostic items, by measurements north and west of the appropriate unit datum and the depth below surface.

Rapid completion of the laboratory procedures was considered crucial for the 1982 project, considering the magnitude of recoveries expected. Given the budget and time restrictions under which the project operated, the proximate goal was the processing of all materials recovered by the end of the first week in September. Four of the excavation crew worked during that final week in the laboratory and, with the exception of one unit, all initial laboratory procedures were indeed completed by that time.

In general, each person was responsible for cataloguing his or her own unit recoveries. Artifacts were washed with water and/or brushed, and then allowed to air dry. Diagnostic items were catalogued individually with each artifact having its own identification number. Undiagnostic materials were grouped by level by class and given only one number. The catalogue designation consisted of the site's Borden number, the unit number and the catalogue number, e.g., DlMa-1, 101-15 (projectile point from Unit 101) or DlMa-1, 99-47 (35 flakes from Level 1 of Unit 99). In some instances it was not until analysis began that diagnostic items were recognized among the groups of flakes, bones or sherds that had been given only one catalogue number. In such cases, a secondary number was added to the original catalogue number as an identifier, e.g., 125-260-3 (bone bead or whistle fragment from Unit 125). All of the materials from a unit were catalogued in prescribed order, level by level. In using the catalogue then, one finds the artifacts arranged in both the chronological and stratigraphic order in which they were excavated. With this order established, it seemed unnecessary to also affix level designations to the artifacts, as has been done in previous years. Because no one standard depth has been used for an excavation level, it would be impossible to compare stratigraphic positions of artifacts recovered in different years without looking up exact proveniences in the relevant catalogues anyway.

During the 1982 field season, approximately 27 m^3 of soil were excavated from 27 1 x 1 metre units. From these units, a total of 66,000 pieces of bone, 2335 lithic and 814 ceramic items were recovered, cleaned, catalogued and analyzed.

CHAPTER II

LANDSCAPE EVOLUTION, STABILITY AND AGE ASSESSMENT

HYDROLOGY AND LANDFORMS: THE AGING LANDSCAPE

The Assiniboine and Little Saskatchewan Systems

The current landscape is dominated by the postglacial Assiniboine meltwater stream valley. As such, geomorphic processes in the area are largely controlled by river-valley relationships, where the modern Assiniboine River modifies the slope of the valley created by its ancestral form and erosional processes resculpt the face of the adjoining valley walls (see Figure 11).

The river itself is massively underfit for the valley it occupies and has not regained its bankfull stage since early deglaciation. It displays a well developed meander belt where the amplitude of the meanders do not grow. In other words, the river is not readjusting to a new regime and the belt of meanders appears to be comparatively stable. The Assiniboine River has, therefore, been operating under the present slope and discharge conditions for a long period of time and is not actively widening its channel but is growing deeper instead (Newbury: Personal Communication). The erosion of valley fill has resulted in the general slope of the valley becoming steeper.

As a function of river dynamics, the meanders themselves are continuously moving downstream in a "barber pole"-like fashion. This can be visualized as a taut rope which is flicked, so that the resultant wave travels the length of the rope. Indications of extensive meander activity are apparent in the occurrence of numerous cut off channels, known as oxbows. Also in evidence are shute cutoffs which occur during periods of high flow and

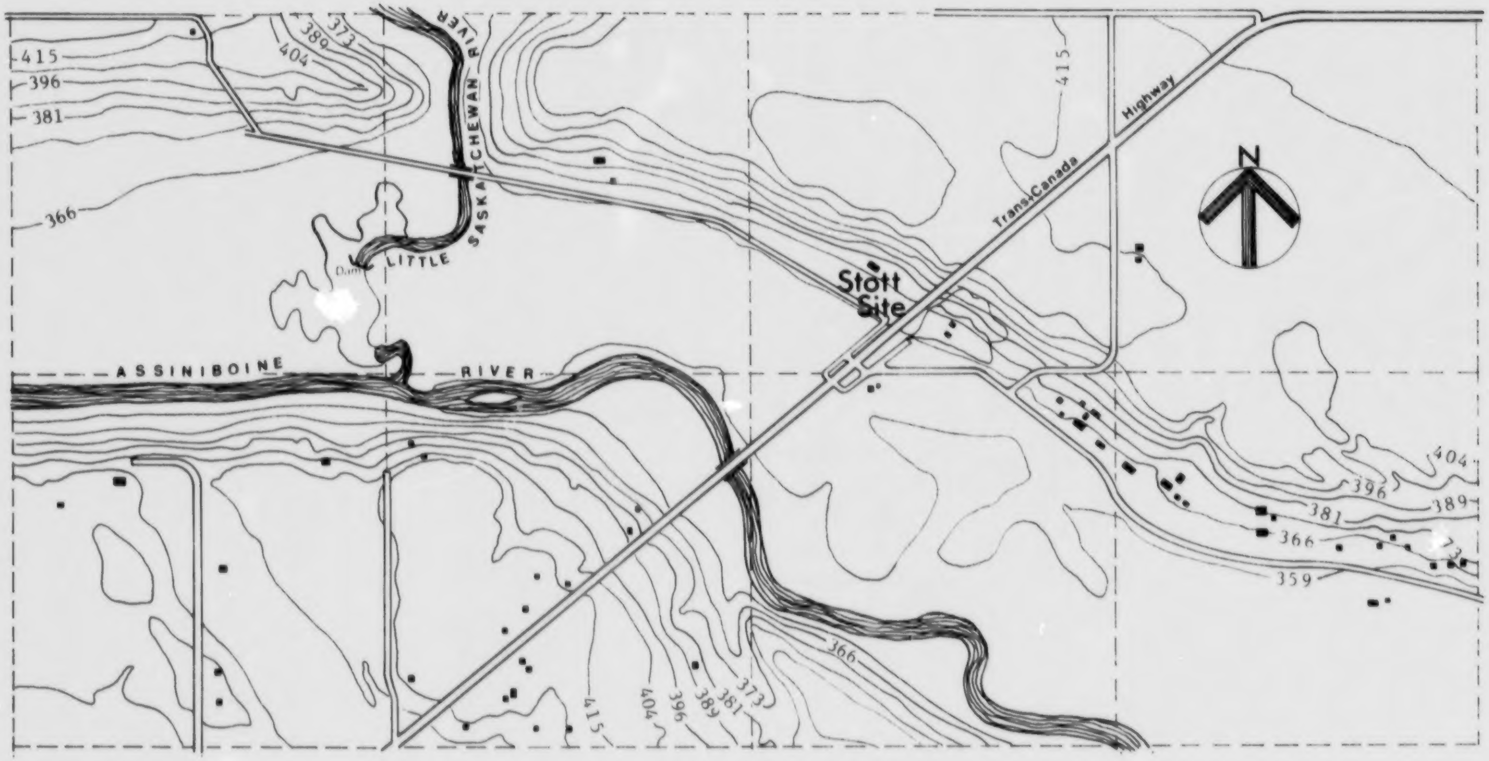

N
Trans-Canada Highway
Stott Site
LITTLE SASKATCHEWAN RIVER
Dam
ASSINIBOINE RIVER
415
396
381
389
373
404
366
359

Figure 11. Topographic map of the Stott Site area.

neck cutoffs, which develop when the sides of a meander form a tight loop that is subsequently bypassed. Scroll bars, ie., ridge and swail topography, are also common.

The rate of progression of meanders is of some interest, because it may be possible to infer when river meanders were nearest to the site area. Dateable material in old meanders should provide an approximate time, while the sequence of vegetation communities in the valley bottomlands may be used to infer meander movement. The occurrence of oak stands near the river's edge, for example, indicates where the river is cutting. Because this species normally favours comparatively dry, well-drained conditions, the appearance of oak or similar species suggests that the river is cutting its banks, has removed the hydrophytic plants which commonly grow on moist, riverside locations and is eroding established forest stands. Conversely, if the riverside is characterized by a normal distribution of expected vegetational sequences, the rate of meander movement may be inferred to be slow.

A comparison of old aerial photos with contemporary ones (Figures 5 and 6) may also give some indication of meander movement over time, although aerial photos are largely limited by the comparatively short time periods they encompass. Here, the comparison of a photo taken in 1947 with one taken in 1980 shows little change in the downstream progression of meanders, although the size of some cutoff channels has noticeably diminished in this short time span. It is probable, therefore, that the meanders are relatively short-lived hydrological features. However, the rate at which they have diminished may also have been influenced by current agricultural activity in the alluvial bottomlands.

In general, therefore, the Assiniboine River has operated under its present hydrologic regime since the postglacial spillway phase and, since that time, a comparatively uniform meander system has formed in the valley bottom with meanders progressing continually downstream. A major exception to these conditions, however, occurs at the junction of the Little Saskatchewan River with the Assiniboine. At this point the Little Saskatchewan has deposited coarse-textured materials, which have formed a small, lateral alluvial fan in the middle of the valley through which the Assiniboine River must pass (see Figure 11). These coarse materials are transported over the comparatively steep gradient of the valley face by the Little Saskatchewan, but are deposited in the valley bottom where the velocity of the stream is no longer sufficient to carry the materials. As a consequence, the Assiniboine channel is forced around these deposits to the opposite valley wall and a straightening of the river channel takes place. The smooth course of the Assiniboine upstream from the Little Saskatchewan indicates a comparable effect of the fan both upstream and downstream from the confluence of the rivers. Under these conditions, the Assiniboine channel is not only straightened, but stabilized as well. Although, over time, the Assiniboine River will act to remove these reworked valley materials, as long as the smaller stream continues to be active, fresh coarse materials will continue to be added to the valley bottom. Hence, for the time period the Little Saskatchewan has been active in the past, the Assiniboine channel would have been forced against the south valley wall and thereby stabilized into an unmeandering form. Although a precise date for the formation of the Little Saskatchewan River system is not known, it is probably of an equivalent age to that of the postglacial spillway Assiniboine River. In other words, it is probably of periglacial age and this stable episode almost certainly encompasses all cultural periods.

Broadly speaking, these hydrologic conditions contribute to a stable valley slope and area, with the exception of the south valley slope adjacent to the straightened portion of the Assiniboine channel. Here the valley face is substantially steeper than along the opposing valley wall, as restricted channel flow continues to erode the slope toe. The cutting of basal materials results in heightened slope instability, slumping and a generally steeper aspect than the surrounding portions of the landscape unaffected by hydrologic conditions.

Relief relationships around the Little Saskatchewan River suggest intense erosion along the small stream valley, showing a steep grade relative to the surrounding landscape. As the stream spills over the valley face, it has become deeply incised into the slope in response to the comparatively steep gradient. The gradient has produced a relatively stable form of the stream for that particular portion ranging from the valley top to the valley floor, where the stream then begins to meander through its own alluvial fan. Although the deeply incised portion of the stream has a comparatively stable form, the adjoining land surfaces do not; they are subject to severe erosion.

Three main points are worthy of particular emphasis, in light of their potential archaeological significance:

1. The unmeandered channel of the Assiniboine River, which occurs near DlMa-1, comprises an area of stability in the otherwise normally meandering movement of the river. Because the form of the channel has not changed since periglacial times, it is likely that the river has maintained this form throughout cultural times. This segment of the river, therefore, provides the best potential for recovery of _in situ_ cultural materials. Its form, over time, is known and it is

also less likely to have eroded previously deposited artifacts, at least along its north bank.

The lateral downstream movement of meanders would have removed cultural materials, making difficult any prediction as to where particular portions of the river were at specific periods in the past. Intense meandering downstream from its confluence with the Little Saskatchewan River signals the point at which the influence of the alluvial fan on the Assiniboine River course lessens. Unrestricted by the influence of Little Saskatchewan deposition, this portion of the channel is subject to intense meander activity and is less likely to retain *in situ* cultural materials. Furthermore, postulating the use of current cutoff channels as potential bison crossing places or encampment sites is risky, because these oxbows may not have existed in their current form in prehistoric times.

The Little Saskatchewan system likely provided an important natural access route for human and animal traffic from the alluvial bottom lands to the upper elevation prairie lands (see Tanner quote, p. 1). Also, a smaller flow system such as the Little Saskatchewan would provide more readily accessible water in winter months, because a large proportion of it comes from ground water sources and is, therefore, less likely to freeze. The comparatively steep gradient of the stream as it spills over the valley face would also help inhibit freezing and thereby provide a valuable source of drinking water at a time when available surface water would be at a seasonal low. Furthermore, hydrologically, the stable form of the stream along the valley slope would promote recovery of *in situ* cultural remains. Conversely, the intense erosion of adjoining land surfaces would limit their recovery.

General Landscape Characteristics

At highest elevations, the landscape is dominated by a comparatively level to gently undulating lacustrine plain. Formed following the drainage of Glacial Lakes Brandon and Souris to Lake Agassiz levels, it caps the Assiniboine spillway valley and adjoins the till and bedrock composed valley slopes (see Figures 12 and 13).

Alluvial terraces are commonly among the oldest portions of many landscapes, because they are typically one of the first portions of the regolith to be exposed following glaciation and the subsidence of postglacial streams. At least one alluvial terrace is known in the DlMa-1 area, occurring at an elevation of approximately 398-399 m asl on the farm side of the site. Excavation Units 99, 100, 101 and 125 are located on this terrace. The age of a terrace may be determined by correlating its elevation with those of known Lake Agassiz beachlines.

A major influence on the form of a river is its base level, that is, the lowest point on the river. In this case, it is the point at which the Assiniboine emptied into Lake Agassiz. Rivers tend to create stable forms in response to changes in lake level, adjusting and stabilizing with respect to new base levels. This may be done in a variety of means; however, at DlMa-1, the river had to down cut rapidly to stabilize its form, thereby abandoning this excavated terrace. Beachlines, on the other hand, indicate periods of relative lake stability and all major beachlines in the province have been dated according to the radiocarbon ages of driftwood, fossil shell and other

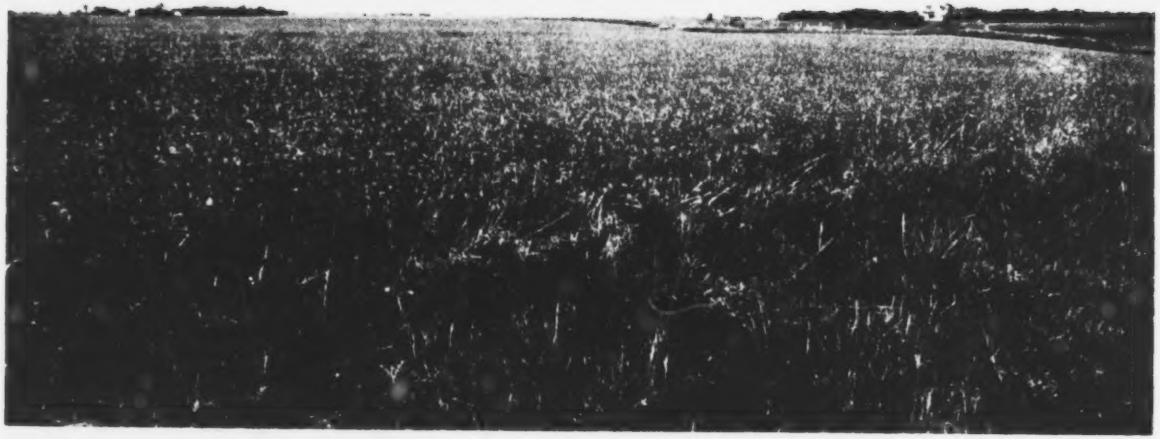


Figure 12. Valley top on the farm side of the site. A view of the gently rolling terrain of the lacustrine bottomland as it caps the north valley wall.

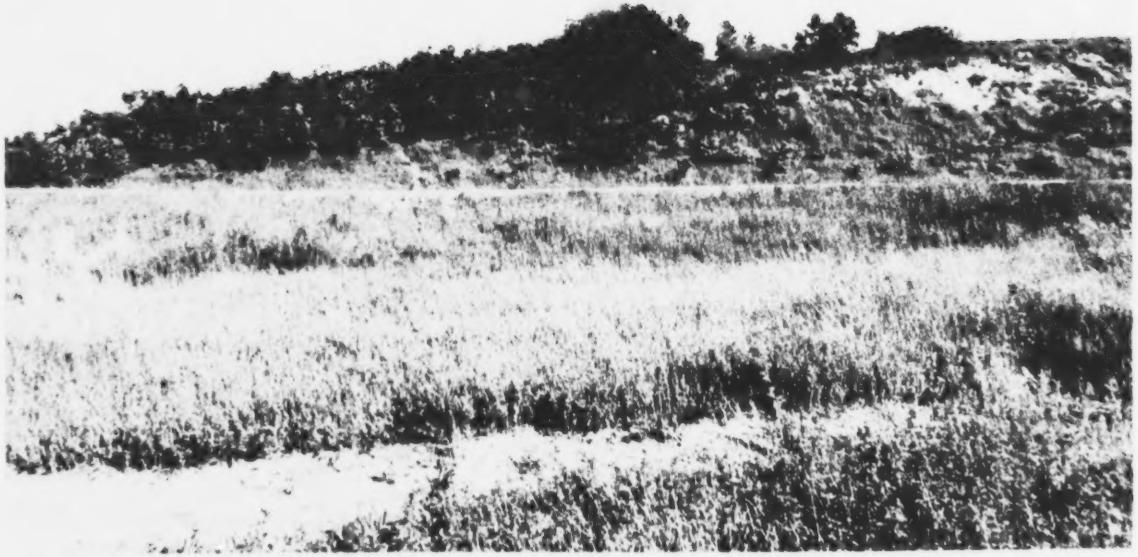


Figure 13. Cross section of the north wall of the Assiniboine Valley. The lacustrine plain is seen at the top, with the valley wall sloping away to the alluvial bottomland.

organic materials. The elevation of the uppermost DlMa-1 terrace may, therefore, be correlated with the Herman phase of Lake Agassiz, during which time both the glacial lake and the spillway system were at their elevational peak. According to Klassen (n.d., 1972), maximum spillway flow occurred at about 13,000 - 14,000 years BP. At this time the meltwater river filled the entire valley and carved these early landscape features. While it is probable that the terrace developed in response to a change in base level and represents a lower spillway channel, it could also have formed as a downcut meander channel. Irrespective of method of formation, however, the terrace, terrace scarp or steep slope, and the adjoining lacustrine plain at the Prairie level comprise the oldest portions of the site landscape.

Given the long established stream regimens of the major flow systems in the immediate DlMa-1 area, the only major form of surface water erosion is gullying -- a channeling of runoff waters. The impact of gully erosion is apparent in the widespread fluvial dissection and differential erosion of the Assiniboine valley walls. At DlMa-1, the erosion of gullys back into the land surface has produced a strongly dissected landscape. The subsequent rounding-off of the gullied land surface has left a terrain populated with small, knoll-like resistant hillocks. The rounded, hummocky, gentle undulations of the land surface suggest that, although gully erosion was once an important factor in resculpting the periglacial terrain, the rate of gullying has declined over time. The progressive decline of the angle of the valley slope by erosion has reduced the impact of gullying and the moderate curves of the dissected slopes indicate a general maturing of the landscape. It also signifies that the area has long been free of river erosion, again through the controlling effect of the Little Saskatchewan fan. Surface features, then, are older and have been more stable for longer periods of time here than for much of the surrounding landscape. In contrast, fluvially dissected terrain along the south valley wall adjacent to the unmeandered portion of the Assiniboine River shows deeply incised, sharp angled gullys actively eroding the valley face. The river is forced against the valley wall and undercuts its base. The resultant slump of slope materials into the valley bottom provides new steep surfaces on which another cycle of gullying can take place. In this way the presence of fluvially dissected terrain can be used to distinguish new land surfaces from old ones and to provide a good index of stability for differing portions of the landscape (Figures 14 and 15).

Gullying is not the only erosional factor to affect the evolution of slopes in the Assiniboine valley, although it is perhaps the most obvious. Water, in combination with surface materials, has modified slopes through solifluction-type flows, including earth and mud flows. As with gullying, the maximum impact of this type of erosion occurred in the past. In early postglacial times, the region consisted of unstable slopes with little or no vegetation to secure them. Runoff water, together with the large volume of water moving through the spillway valley, triggered massive mud and debris slides directly into the river, with the material subsequently flushed out of the valley and deposited in the Assiniboine delta or Lake Agassiz basin. Other erosional factors include creep, the downslope transport of surface materials under the influence of frost heave and gravity -- evident in the bowed countenance of trees on many slopes -- and mass wasting under gravity alone, which occurs on freshly eroded slopes like those along the south face of the Assiniboine valley (Figures 16 and 17).

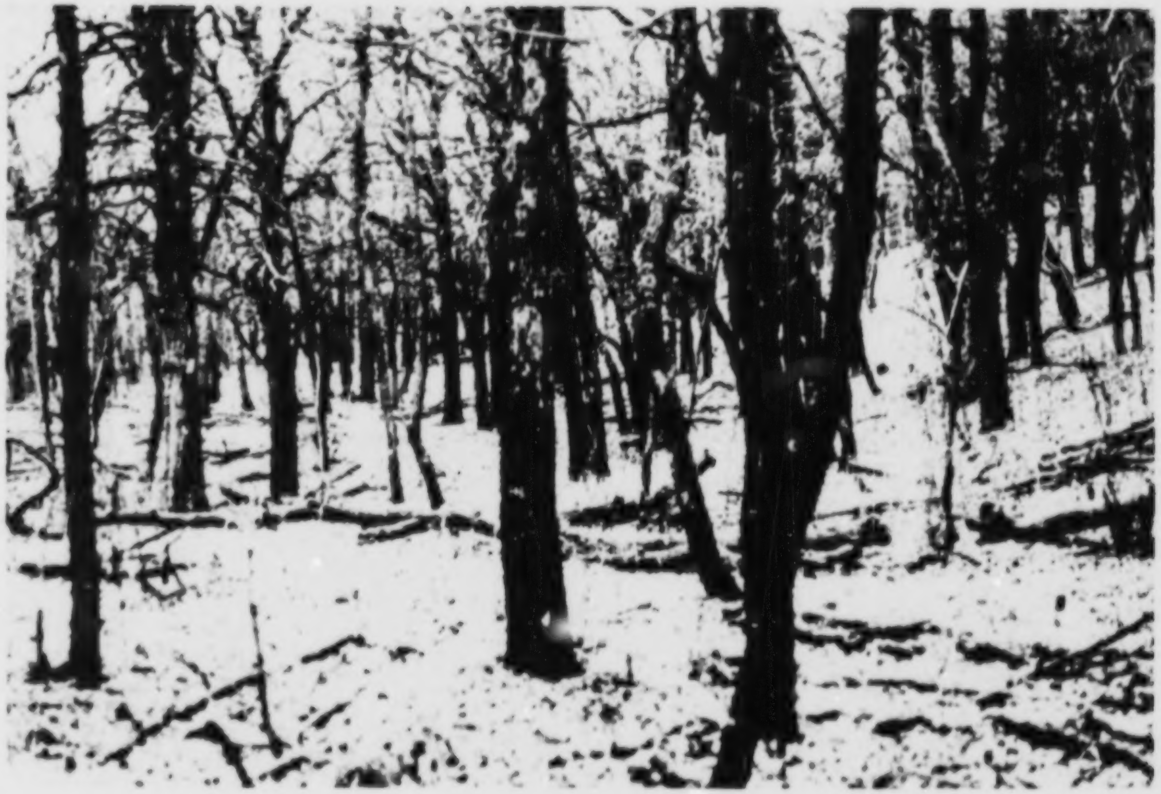


Figure 14. Dissected terrain. A view of the hummocky terrain on the farm side of the site; the well-rounded surface of the till hummocks indicates the old age of the terrain.

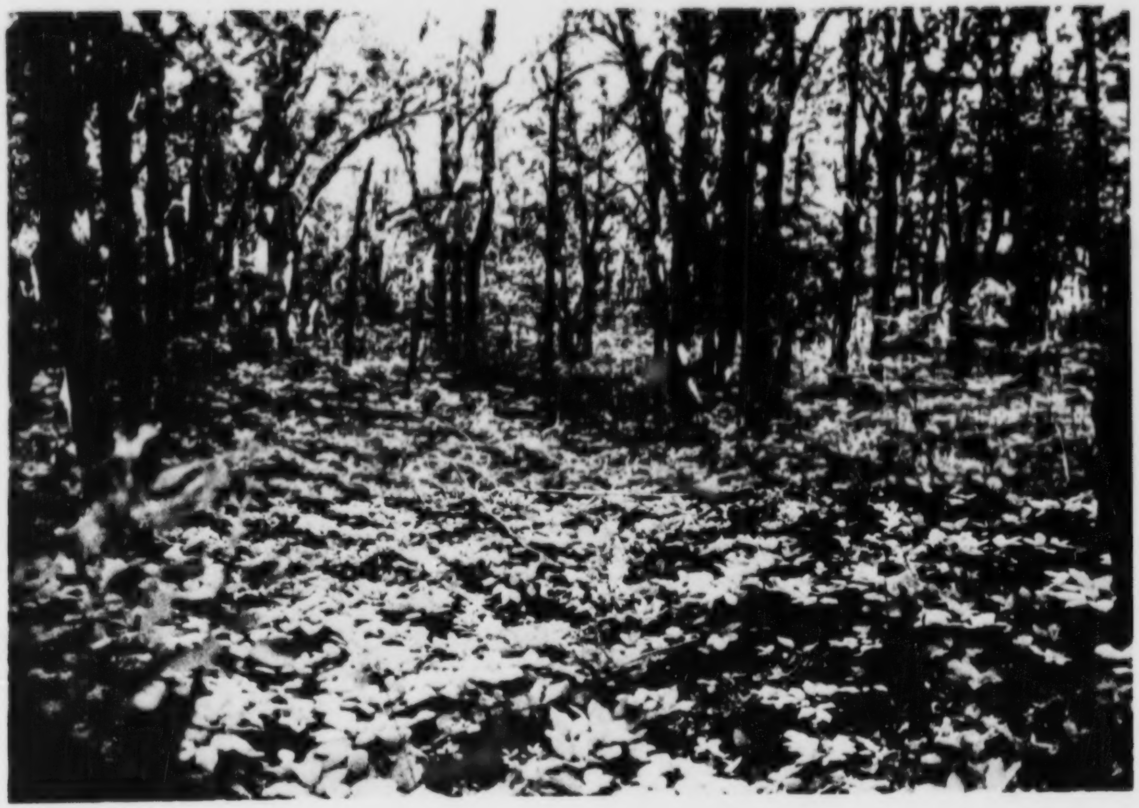


Figure 15. Erosion on the valley wall. A downslope view of an erosion gully on the upper portion of the terrace scarp at the west end of Area F.

Figure 16. Mass movement scar on the upper portion of the valley wall.

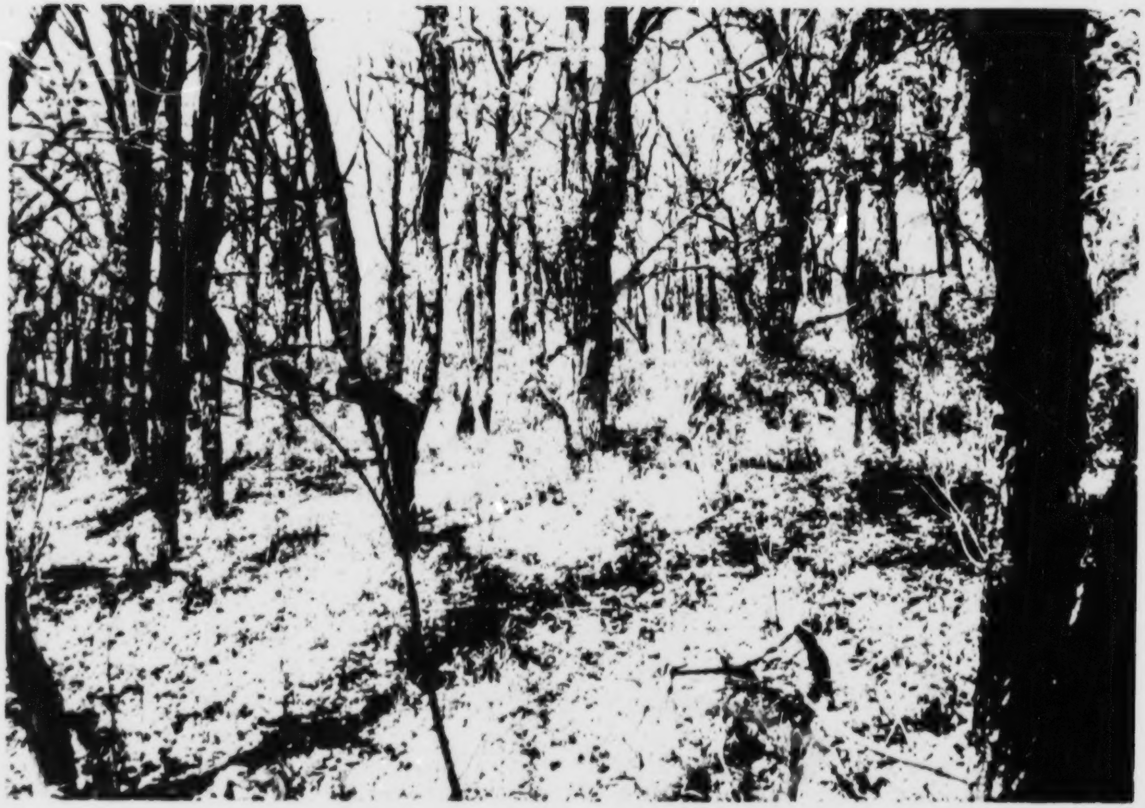


Figure 17. Bowed tree. The bowed tree in the foreground demonstrates the effect of creep; the view is looking upslope on the north valley wall in Area F.

DEPOSITIONAL MATERIALS, ENVIRONMENTS AND SOIL FORMATION

Field examination of sedimentary structures and sedimentological analysis of the depositional materials were used to determine the type of depositional materials occurring in the site area and the depositional environments under which they were laid down. Analysis of grain size and parameters is of importance because the most fundamental property of a sediment is its grain size distribution, which is closely related to the physical forces which are active during its transport and deposition (Muller 1967). Grain size distribution can be used to distinguish between sediments of different environments and facies and to give information on depositional processes and flow conditions (Tucker 1981; Friedman and Sanders 1978). Grain size distribution is of particular interest here because it may provide an index to the resorting that occurred on the landscape in the past, as well as descriptive criteria for the composition of sediments. The latter is necessary for dealing with basic geomorphic problems, such as susceptibility of slopes to slump and erosion from water-related flow, that is, a slope's sensitivity to reworking processes.

Pedogenesis, or soil formation, can also yield valuable information on landscape reworking and stability. In general, soil formation reflects past climatic, vegetational, relief and drainage conditions, as well as the time frame in which they developed (Buol *et al*. 1980). At DlMa-1 pedogenesis is of particular importance, because the type of soil which has developed and its degree of development can provide a good indication of past and current landscape reworking. Pedogenesis can also contribute to a broad assessment of the ages of soils and, hence, of the surfaces in which they formed.

The following is a precis of results obtained through an examination of the deposits and their sedimentary structures, grain size analysis and soil characteristics. Appendix VI contains the laboratory methods used in grain size analysis and some examples of the results.

The Farm Side: Valley Top Sequence

Strat Units 2, 3 and 4, found in Area F on the farm side of DlMa-1 (see Figure 8), are located near the edge of the lacustrine plain which adjoins the Assiniboine meltwater valley. The depositional material, to excavated depth, is of lacustrine origin and consists of three main depositional units. The uppermost unit, comprised of well-sorted loam and sandy loam, is a homogeneous body lacking discernible sedimentary structures. It overlays a comparatively thin band of varved silts and clays. The varves, in turn, overlay the lowermost unit, which consists of very well sorted sands containing numerous thin laminae comprised of graded sands.

Facies analysis suggests that the upper unit was laid down under near-shore conditions of the proglacial lake which occupied the area prior to activation of the Assiniboine spillway. The underlying varves of the middle unit demonstrate that the lake, at that time, had a well developed glacial character with seasonal cycles of deposition. Fine textured clays, suspended in the water during the turbulent summer months, settled out during the less turbulent winters when the lake was frozen. Conversely, the coarser silts were sufficiently large enough to settle even when the lake was not frozen. The presence of varves also signifies deep water conditions, in contrast to the upper and lower deposits. The lowermost, very well-sorted sands contain only a small portion of coarse silt materials and display abundant rippled sedimentary structures. These thin laminations, combined with the well-sorted nature of the deposit, suggest a high energy depositional environment such as a beach zone of the ice margin lake.

Over the life of the proglacial lake, therefore, this area comprised a beach zone of the lake which was subsequently submerged under deeper water conditions when increased glacial melt added to the volume of water in the lake basin. These deep water conditions were, however, short-lived in the lake basin and the lake returned to shallower depths prior to final drainage at lower elevations. Variations in the degree of sorting and the proportion of coarse to fine materials in the uppermost unit suggest minor fluctuations in the lake level during later stages. Deeper water conditions may have lasted longer than indicated by the thinness of the varved sediments, if turbidity currents lifted these deposits from the lake bottom, resorted and redeposited them elsewhere. The lacustrine material itself consists of sands and silts resorted by wave action from the till materials it now overlays.

These deposits are generally equivalent throughout the three strat units. However, variations in depositional material within the units probably result from either the unevenness of the till surface on which the lacustrine sediments were laid down or the uneven erosion of surface materials in early postglacial times. Therefore, the three strat units do not correlate precisely with depth.

During this early postglacial period, the impact of erosional processes was at a maximum and the coarse, cohesionless material would have offered little resistance to the large volume of runoff water moving over the unstable slopes. Much of this lacustrine material would have been eroded and removed from the Assiniboine valley at this time. The effect of wind erosion would also have been at a peak during this period. The lack of aeolian surface structures, however, indicates that the area was stabilized by vegetation before active dune formation could take place. Furthermore, the cohesionless nature of the material suggests that this portion of the valley probably achieved a more stable angle of repose earlier than surrounding portions of the landscape and, with the exception of slump, has been less subject to ongoing processes of erosion than the adjoining terrace scarp. It is now comparatively stable relative to other landscape positions.

Orthic Dark Gray Chernozemic soils have developed in the lacustrine surface. They are relict paleosolic soils, initially developed under subarid or subhumid, primarily grassland conditions, which are not currently in equilibrium with existing environmental conditions. The climatic trend is now toward cooler, moister conditions, which favour forest vegetation over grasses. Consequently, the soil is changing its properties in response to the modified climate and the profile is "graying-out" as a natural function of this change. The prominent Ah horizon, so characteristic of Chernozemic soils, is no longer actively replenished by the addition of organic material through the decay of grass roots. Although trees do contribute a large amount of organic material to the solum when they die, they are long-lived in comparison to grasses and only add small amounts on a seasonal basis. The Ah horizon is, therefore, a relict feature of the soil, remaining as a remnant characteristic of a no longer existing environment. The shift to subhumid conditions also signifies the enhanced availability of surface waters which percolate through the porous parent material, depleting the relict Ah horizon. The effect of these filtrating waters is apparent in the development of a distinct elluvial Ae horizon and a prominent illuvial Bm horizon. The Bm horizon is, in particular, strongly developed and signals the conversion of pre-existing soil properties to contemporary features which are in harmony with current environmental conditions. In time, the relict Ah will be entirely incorporated into the actively developing Ae and Bm horizons; all but the most resistant relict characteristics will disappear. It is possible that poor development of the Ah horizon may relate to past landscape instability, i.e., loss of surface materials from erosional processes, but the coarse texture of the lacustrine parent material also promotes eluviation of the Ah. The transition of soil properties from a grassland to a forested type of profile is therefore accelerated here, relative to Chernozemic soils formed in less porous materials at other locations on the landscape.

Because the genetic properties of soils developed in lacustrine materials are essentially equivalent, the contention that erosion of surface materials is not currently severe and probably occurred prior to or early in the development of the soil is supported. Severe erosion in recent times would have resulted in a truncated soil profile. Figure 18 gives a schematic presentation of the surficial deposits which cap the spillway wall and shows profile characteristics for Dark Gray Chernozemic soils developed in the lacustrine blanket. All soil classificatons are made in accordance with criteria given in CSSC (1978).

The Farm Side: Upper Terrace Scarp Sequence

Strat Units 5, 6 and 7, which dissect the terrace scarp, are located along the 1979 baseline connecting the valley top with the terrace (see Figure 8). Strat Unit 5 is located 15 - 16 m south of Strat Unit 4 at an elevation

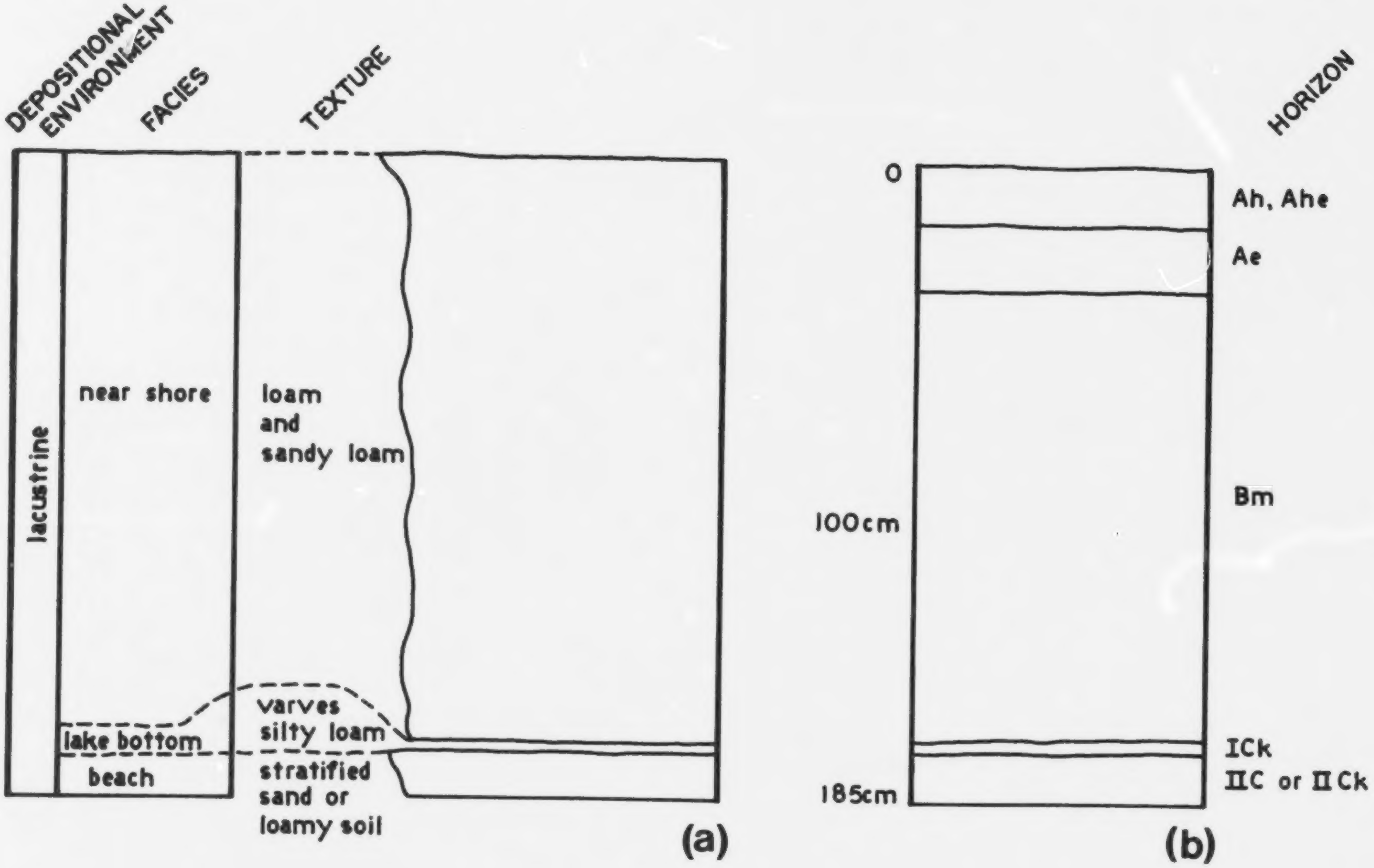

DEPOSITIONAL ENVIRONMENT
FACIES
TEXTURE
lacustrine
near shore
lake bottom
beach
loam and sandy loam
varves silty loam
stratified sand or loamy soil
(a)
HORIZON
0
100cm
185cm
Ah, Ahe
Ae
Bm
ICk
IIC or II Ck
(b)

Figure 18. Depositional units and soil horizons occurring in Strat Unit 4; (a) gives the depositional environment, facies and texture of the deposits, (b) gives the horizon pattern of the Orthic Dark Gray Chernozem developed in the deposits.

of approximately 412 m asl. Strat Unit 6 is situated 15 - 16 m south of Strat Unit 5 at an elevation of approximately 408 m asl and Strat Unit 7 is located 11 - 12 m south of Strat Unit 6 at an approximate elevation of 404 m asl. The slope of the scarp rises at an approximate angle of 15 - 18° from the terrace to Strat Unit 5. From Strat Unit 5 to Strat Unit 4 on the adjoining lacustrine plain, the slope is about 10°.

Strat Unit 5 is located on the convex creep slope of the terrace scarp. Depositional material in this area is predominantly till, consisting of two main units. The uppermost unit is comprised of a comparatively thin layer of unsorted silts and clays combined with fine sands. This surficial unit is underlain by a depositional unit characterized as a heterogeneous mixture of fine textured materials, clay pockets and stones. These small, rounded calcareous stones are common but not abundant, although boulders and large cobbles do appear at the surface nearby.

The heterogeneous nature of the lower unit indicates that it was laid down in a depositional environment in which poor sorting took place and it has not been subjected to resorting processes since then. This depositional unit may, therefore, be unmodified till. (See caveat contained in Appendix VI, Figure 102.) Grain size analysis of the upper unit indicates that although the deposit consists of materials similar to the underlying unmodified till, it differs from the till in that it contains a comparatively higher proportion of fine sands. These coarse textured materials are, in turn, similar to the well sorted fine sands which comprise the neighbouring lacustrine plain. The high proportion of coarse materials in the surficial unit relative to that of the unmodified till and the essential equivalence of these coarse materials with the well-sorted sands of the lacustrine deposits indicate that the surficial deposit is composed of reworked lacustrine and unmodified till materials. Contributed to the creep slope by creep, runoff water and rain-splash, the lake-related sediments have combined with surface till materials to cap the otherwise unmodified till.

Strat Units 6 and 7 demonstrate similar depositional sequences, but differ in the thickness of the reworked lacustrine and till materials as well as the form of sedimentary structures. In contrast to the comparatively shallow reworked lacustrine/till deposit in Strat Unit 5, the thickness of this reworked material increases with downslope distance. Grain size analysis indicates that the depth of the reworked material is at least 40 cm in Strat Unit 6 and 1.17 m in Strat Unit 7. Furthermore, the sedimentary characteristics of the deposits in the two lower strat units show a pronounced churned appearance, which correlates in general with the thickness of the reworked materials. This churned, molded appearance of the reworked material suggests a type of water-lubricated mass movement including earth and mud flows and solifluction, which resulted from the mixing of organic and mineral materials during surface flow.

Soil formation in Strat Unit 5 is an Orthic Regosol. Regosols are poorly developed soils typified by simple A-C profiles. The Ah horizon is only marginally expressed and directly overlays the undeveloped calcareous Ck horizon. The soil is sufficiently short-lived to show little impact from contemporary environmental conditions. Poor development is a function of landscape instability.

Soils developed in Strat Units 6 and 7 are also classified as Orthic Regosols with similarly poorly formed Ah horizons. However, in these units, this poorly expressed organic-enriched horizon is underlain by an Ah/Ck mix which corresponds to the churning flow and displacement of eroded surface materials. Parent materials comprising the Ck horizon in Strat Unit 6 are composed of silty loams and do not differ much texturally from the overlaying depositional material in which the Ah and Ah/Ck horizons occur. Despite the lack of sedimentary structures directly indicative of flow conditions, it is possible to infer, based on textural similarity alone, that the entire profile depth is comprised of transported lacustrine and till materials. In other words, not only is it known that the upper 40 cm of Strat Unit 6 has been deposited under flow conditions, it is possible that the underlying depositional material is not comprised of unmodified till, as in Strat Unit 5, but rather is also a product of the erosive reworking of the slope and extends to unit depth. If this is the case, then the only exposure on the till scarp in which the type of erosionally unmodified till is known would be the lower depositional unit in Strat Unit 5. Analysis of Strat Unit 7 parent materials indicates that the entire profile is comprised of reworked lacustrine and till materials. Therefore, the whole profile is comprised of eroded valley top and slope materials.

Although the lack of sedimentary structures to suggest churning in Strat Unit 5 may be interpreted as indicative of more stable conditions, in fact, soil development is as poor there as on other slope positions. The simple A-C profile in Strat Unit 5 suggests that the slope surface is sufficiently unstable to retard pedogenesis and, therefore, represents a zone of active erosion. While the creep slope is enriched by the addition of eroded material from the neighbouring lake bottom deposits, marginal soil formation indicates that the impact of these erosional processes exceeds the rate of soil development. The creep slope is, therefore, sufficiently unstable to inhibit soil formation.

Conversely, Strat Units 6 and 7 are located on portions of the slope which represent zones of accumulation of materials eroded from upslope positions and the lacustrine plain. Unlike the creep slope on which the dominant modifying processes are creep, runoff and rain-splash, the main erosional process on lower slope positions is mass wasting under the influence of water combined with creep. The thickness of accumulated material increases downslope and, therefore, the depth of material affected by earth flow or solifluction action increases.

In a general sense, this dynamic reworking of landscape materials can be seen as a cycle of ongoing deposition, transport and redeposition of the till source materials. Originally deposited in the wake of glacial retreat, the till materials comprised the earliest postglacial landscape. Subsequent inundation of proglacial lakes resulted in a sorting of the fine sands and silts from the till deposit by wave action. These lacustrine materials were, in turn, massively eroded in periglacial times and since then have been contributed to the edge of the valley wall by creep, runoff and other erosional processes. From the creep slope they are acted upon by lower slope processes, such as various types of fluidized flow and creep. Alternately, lacustrine materials can be contributed directly to lower elevations through gullying, an example of which occurs west of the terrace. Figures 19 and 20 give the depositional sequence, soil type and horizons for the terrace scarp strat units.

The Farm Side: Lower Scarp Sequence

Excavation Units 103, 102 and 104 are located on the lower portion of the terrace scarp and occur at an elevation of between 399 - 400 m asl.

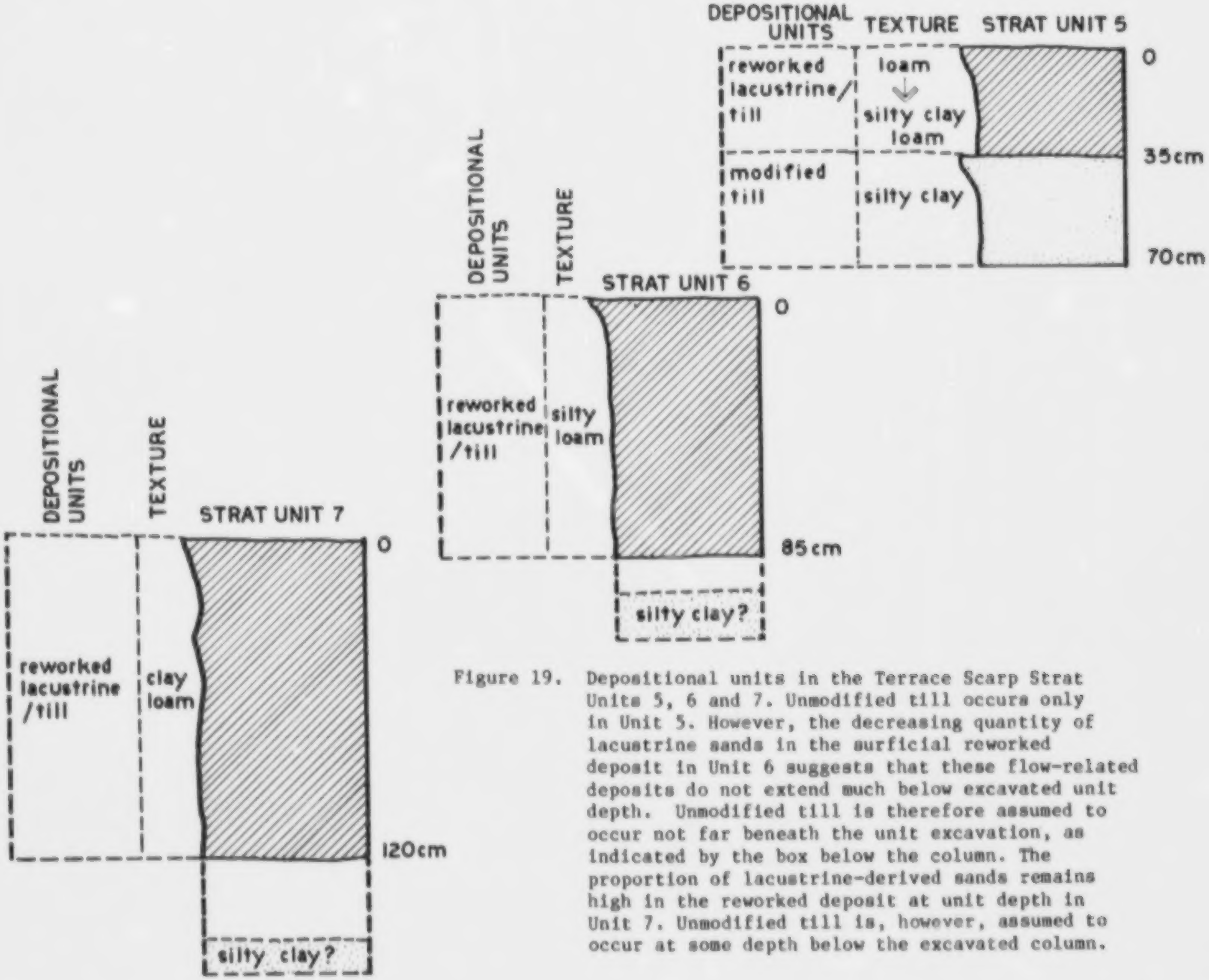

DEPOSITIONAL UNITS
TEXTURE
STRAT UNIT 5
reworked lacustrine/till
loam
silty clay loam
modified till
silty clay
0
35cm
70cm
DEPOSITIONAL UNITS
TEXTURE
STRAT UNIT 6
reworked lacustrine/till
silty loam
0
85cm
silty clay?
DEPOSITIONAL UNITS
TEXTURE
STRAT UNIT 7
reworked lacustrine/till
clay loam
0
120cm
silty clay?

Figure 19. Depositional units in the Terrace Scarp Strat Units 5, 6 and 7. Unmodified till occurs only in Unit 5. However, the decreasing quantity of lacustrine sands in the surficial reworked deposit in Unit 6 suggests that these flow-related deposits do not extend much below excavated unit depth. Unmodified till is therefore assumed to occur not far beneath the unit excavation, as indicated by the box below the column. The proportion of lacustrine-derived sands remains high in the reworked deposit at unit depth in Unit 7. Unmodified till is, however, assumed to occur at some depth below the excavated column.

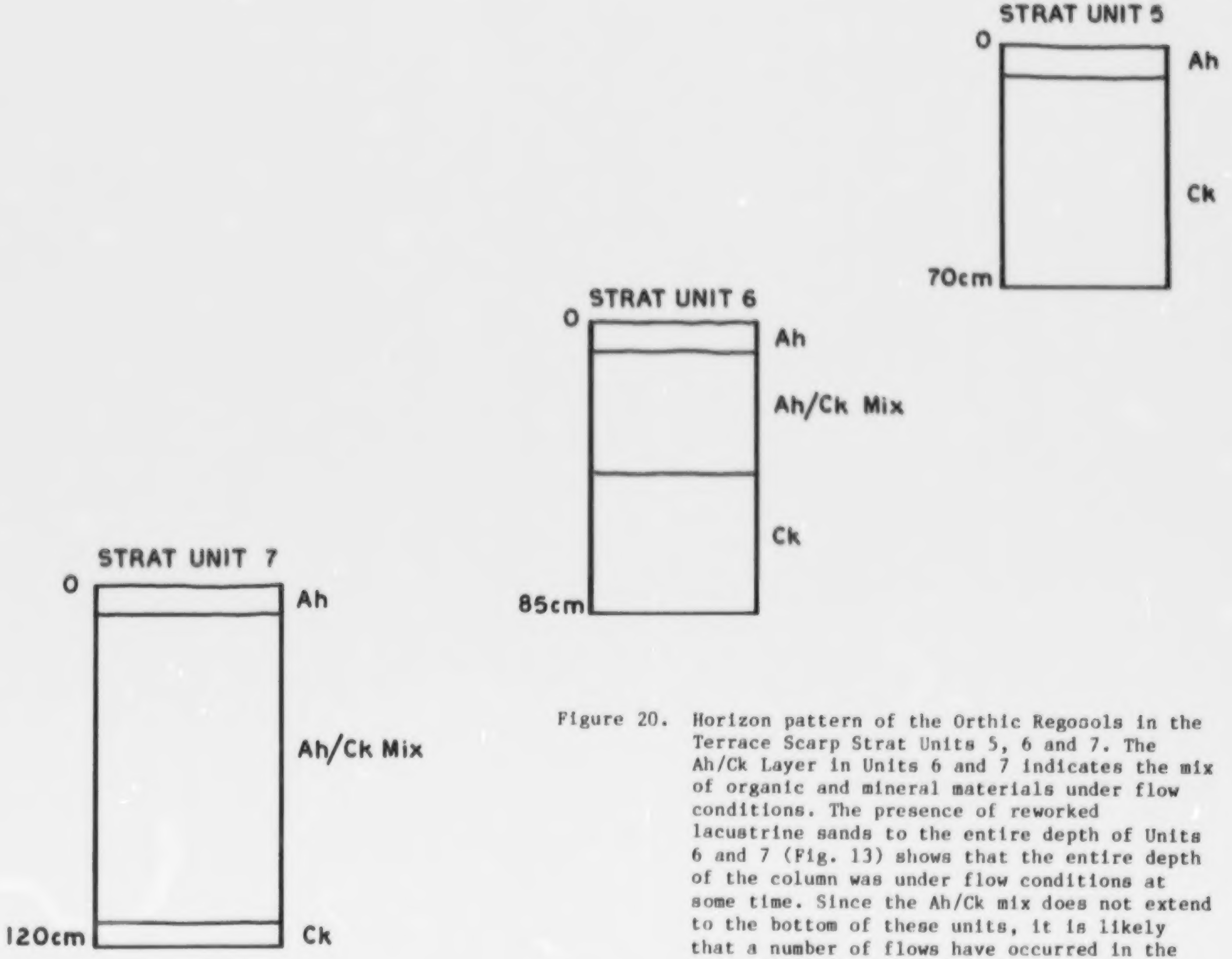

STRAT UNIT 5
0
Ah
Ck
70cm
STRAT UNIT 6
0
Ah
Ah/Ck Mix
Ck
85cm
STRAT UNIT 7
0
Ah
Ah/Ck Mix
Ck
120cm

Figure 20. Horizon pattern of the Orthic Regosols in the Terrace Scarp Strat Units 5, 6 and 7. The Ah/Ck Layer in Units 6 and 7 indicates the mix of organic and mineral materials under flow conditions. The presence of reworked lacustrine sands to the entire depth of Units 6 and 7 (Fig. 13) shows that the entire depth of the column was under flow conditions at some time. Since the Ah/Ck mix does not extend to the bottom of these units, it is likely that a number of flows have occurred in the past, of which this Ah/Ck mix may have been the most recent.

Situated approximately one metre above the slope base, they extend vertically with the moderate slope and are north-south oriented (see Figure 8).

Depositional material, to the depth of excavation, consists of reworked lacustrine and till materials and is comprised of two separate depositional units. The upper depositional unit, which constitutes the current ground surface, consists of flow materials of an approximate thickness of 35 cm. These reworked land surface materials overlay a separate unit of reworked lacustrine and till materials, comprising a former flow surface. It extends, in depth, to the bottom of the excavated units and is at least 60 cm in thickness. The lower depositional unit contains sedimentary structures indicating the churning of surface organic and mineral materials, which are similar to those appearing in Strat Units 6 and 7. It is likely that this lower depositional unit correlates with the main depositional units of Strat Units 6 and 7. However, it is also possible that these units represent similar processes operating over a generally similar time frame.

The depositional units contain a modern, poorly developed soil and a poorly developed buried paleosol. They are Cumulic Regosols. Pedologic characteristics of the developing soil in the upper flow surface indicates that it is not only the latest flow surface, but that this displacement of surface materials occurred in the comparatively recent past. Poor Ah horizon formation and the lack of other genetic soil properties suggest that the soil has not been developing for a sufficiently long enough time to exhibit profile characteristics reflective of current climatic and vegetational conditions. Because soil properties such as Ah horizon formation are, in pedological terms, among the more rapidly developing soil features, the poor degree of development of this organic layer indicates a relatively short time frame.

Furthermore, because degree of soil development in this area is largely a function of landscape instability, the Cumulic Regosol profile indicates that the surface was under flow conditions in the relatively recent past.

These upper flow materials overlay an earlier flow surface, containing a buried Ah horizon which, though also poorly formed, is more well developed that its modern counterpart despite the fact that it is not deeply buried and is, therefore, included in the current zone of biological activity where the action of plant and animal organisms promote decay. This condition indicates that both the paleosol and the buried surface in which it occurs were longer-lived than the existing surface. The Ahb horizon forms a discrete, unbroken layer and, though poorly developed, is readily apparent along the east walls of all the lower scarp units. This horizon is, however, typically discontinuous or entirely absent along the north walls of the three units. The intermittent appearance of the buried Ah horizon suggests a mechanical disruption of the former surface such as could have occurred through the liquified movement of the more recent flow surface.

The Ahb horizon overlays a horizon characterized by a mixture of Ahb and Ck materials. This Ahb/Ck mix is the pedological equivalent of the sedimentary structures which indicate the churning mix of organic and mineral materials under flow conditions. Following flow, this mix of surface materials would have extended to the top of the profile, but the upper portion of the horizon has since been incorporated into the then developing Ah horizon. The churned Ahb/Ck horizon overlays, in turn, a Ck horizon which is likewise comprised of reworked lake-related and till materials, but lacks the characteristic churning of the upper horizon. It forms the lower portion of the flow surface.

Age assessment of the soils contained in the two flow surfaces suggests that neither surface was long-lived, although the buried paleosol had been developing over a longer time period than its modern counterpart. The buried surface was, therefore, stable longer than the current surface, although neither surface had been stable long enough to allow for the development of soils with distinct or slow-forming features. Although rates of soil formation are not a well understood aspect of pedogenesis, a general appraisal of the age of the soils is possible. Based on the degree of Ah horizon formation, it is unlikely the soils had been developing on either surface for more than a few hundred years. The poor degree of development evident in both soils indicates a pattern of landscape instability extending from former into modern times. Figure 21 gives the depositional sequence, soil type and horizons for lower scarp Excavation Unit 104.

Soils commonly reflect the climate and vegetation under which they have developed. At DlMa-1, however, the interpretation of past environmental parameters is restricted by the general absence of most diagnostic soil properties. With the exception of marginal Ah formation, the landscape has not been sufficiently stable to permit formation of other, less rapidly developing soil features. Ah horizons characteristically achieve maximum expression in Chernozemic soils which, as indicated, develop under subarid to subhumid grassland or grassland-forest environments. If the organic horizon is a Chernozemic Ah, this would, therefore, suggest formation under grasses or grasses and trees, rather than under exclusively forest vegetation. Given, however, that the degree of development of the current and pre-existing Ah horizons places them in a recent time frame and because the contemporary climatic trend is toward cooler, moister conditions favouring forest vegetation, a Chernozemic Ah could only have developed if the slope had

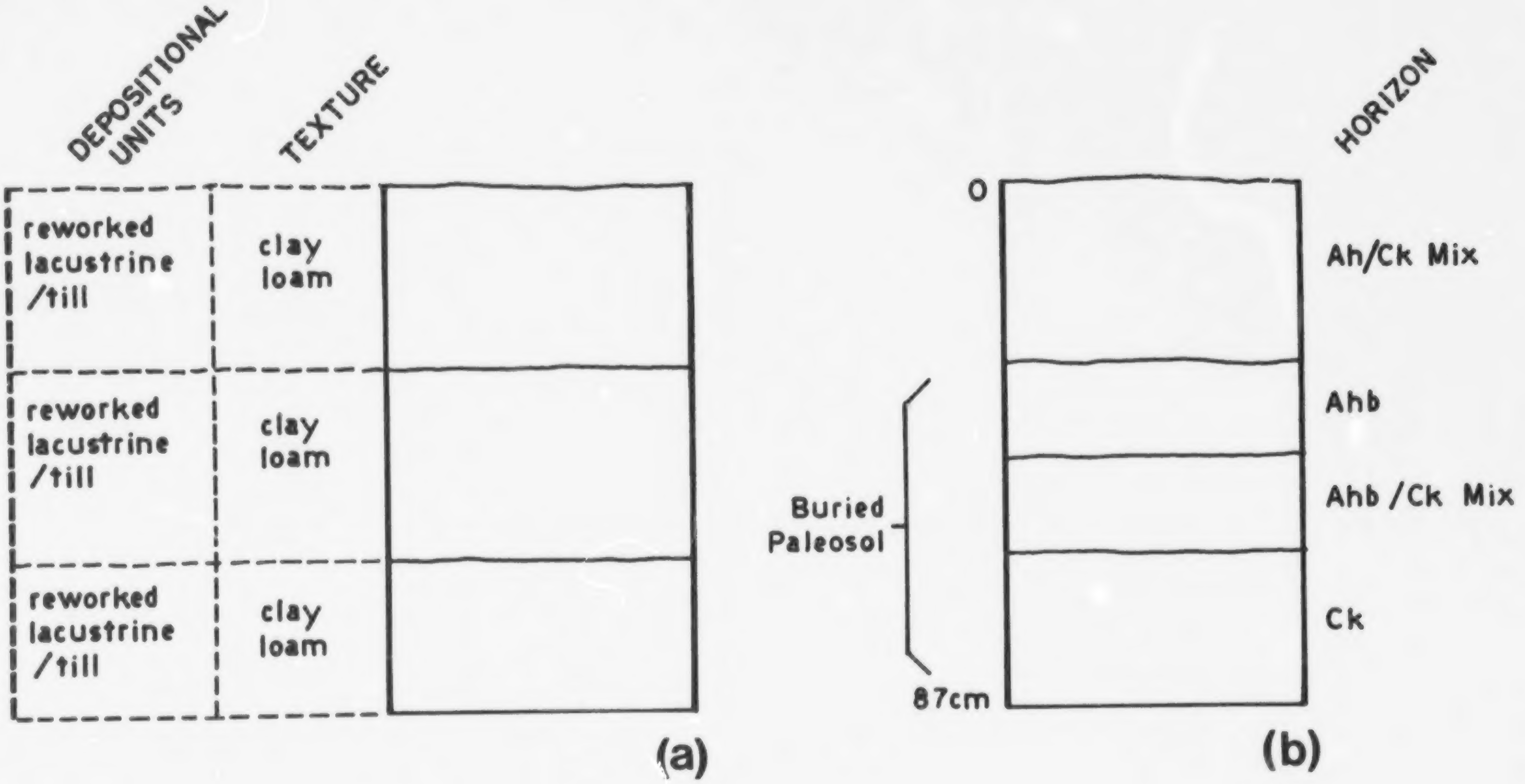

DEPOSITIONAL UNITS
TEXTURE
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
(a)
HORIZON
0
Ah/Ck Mix
Ahb
Ahb /Ck Mix
Ck
87cm
Buried Paleosol
(b)

Figure 21. Depositional units and soil characteristics in Lower Terrace Scarp Unit 104. (a) shows the depositional units and the texture of the depositional material; (b) gives the horizon pattern for the Cumulic Regosol formed in the deposits.

been subjected to destabilizing factors which would have promoted the growth of grasses. Fire, for example, would favour growth of grasses over trees, as well as increase slope instability, thereby enhancing the impact of erosional processes. On the other hand, the normal expression of soils forming under current climatic and vegetation regime is to produce Luvisolic soils or to convert former Chernozems to Luvisolic types. If the organic horizons are Luvisolic Ah horizons, their thicknesses are more in line with the expected degree of development for this type of soil. In either case, the absence of comparatively slowly forming features attests to the general instability of the land surface.

In summary then, a broad appraisal of scarp depositional materials, sedimentary structures and soil formation yields the following significant points:

1. Reworking of a till landscape is difficult to demonstrate using sedimentological methods. The occurrence of well-sorted, coarse-textured lacustrine deposits capping the valley top, however, provides a convenient marker system to gauge where reworking has occurred on the landscape. Because the creep slope around Strat Unit 5 is actively eroding and is not itself a major zone of accumulation of colluvial materials, the composition of the unmodified till is known at this location. Furthermore, it comprises the only portion of the excavated area of the site in which the composition of the till is known. (See Appendix VI, Figure 102.) This occurrence is important because the amount of coarse materials contained in the till is low. Therefore, the appearance of well-sorted, coarse-textured materials in the surface layers of adjoining slope

units indicates enrichment from reworking processes. This is most apparent in creep slope Strat Unit 5. Adjoining the lacustrine plain, the upper depositional unit contains a high proportion of lacustrine-derived sands, while the underlying unmodified till contains only small amounts of coarse materials. The relative concentration of lacustrine-derived sands over the surface of the site thereby provides a useful index to the location of reworking on the landscape and, by the type of sorting evident in the reworked material, it may also suggest the form of the erosional processes, i.e., sorted or unsorted erosional processes. Typically, the amount of sands contained in reworked deposits decreases with distance from the lacustrine plain and can vary with depth. In Strat Unit 6 the amount of lacustrine-derived sands consistently decreases from the unit surface, suggesting that the depth of water-lubricated mass movements is comparatively shallow and unmodified till may occur not much below the excavated unit depth.

2. In general, no portion of the scarp is unaffected by slope modifying processes, which strictly limits the potential for recovery of *in situ* cultural remains. The creep slope around Strat Unit 5 is actively eroding. Past excavations have shown that cultural materials were commonly found on the terrace scarp, but no cultural remains were recovered from Strat Unit 5. The erosion of slope materials and their contained artifacts could account for the absence of cultural materials in this site position as the artifacts would have been transported downslope with the eroded soil materials. If this is indeed the case, then it is likely that the slope has been actively eroding within the past 2,000 years, thereby effectively

straddling the ages of all identified cultural materials. Furthermore, the poor expression of soil formation and the lack of slow-forming soil properties indicate that erosion is ongoing, although probably at a declining rate. The creep slope is, therefore, currently unstable and will not yield in situ cultural remains. Archaeological materials found in this portion of the site will have been redistributed from the lacustrine plain.

3. Strat Units 6 and 7, located on lower scarp positions, have been strongly affected by earth or solifluction-type flow conditions and are largely composed of eroded materials from upslope positions. The contained archaeological materials would also have been affected, although the precise nature of the effect of reworking depends upon an understanding of the mechanisms by which the various flow processes operate. Broadly speaking, this portion of the scarp would contain both reworked archaeological materials in combination with in situ materials. For the archaeologist, a distinction between the two would be difficult.

4. Units 103, 102 and 104, located on the lower aspect of the terrace scarp, have also been affected by earth or solifluction-type flows. The entire profile of these units, consisting of reworked lacustrine and till materials, exhibits two distinct flow episodes. They represent individual land surfaces separated by periods of soil formation, i.e., intervals of stability. The upper depositional unit was under flow conditions in relatively recent times, as indicated by marginal Ah horizon formation. Conversely, the buried surface was somewhat longer-lived, forming a more distinct organic horizon. It

is in this stabilized flow surface of excavation unit 102 that a buried vertical bone feature was dug (see Chapter IV for a discussion of the vertical bone feature). The vertical aspect of the bone and the distinct outlines of the pit suggest that it was not disturbed by subsequent earth or solifluction-type flows. Instead, the more recent flow surface buried this portion of the former surface. This type of burial is characteristic of flow mechanics, when the flow originates from an upslope position. The underlying flow surface was comparatively short-lived, being rapidly covered by the succeeding flow.

5. Age assessment of the various scarp surfaces is based on the pedologic properties of the soils which have developed in them. All soils on the terrace scarp are poorly developed, typically lacking most diagnostic soil features. Age assessment, therefore, can only rely on the most rapid developing soil property, i.e., degree of Ah formation. Organic horizons, although rapidly forming, are also among the first soil features to decay if buried near the contemporary surface. Also, they are among the first features to be converted to, or incorporated within, other properties if environmental factors alter. The Ah horizon of the Chernozemic soil developed in the lacustrine plain, for example, is being depleted by a climatic change which fosters its replacement with a developing Ae horizon. In a general sense, environmental conditions no longer favour the formation of an Ah horizon and its rate of formation has declined over time. Cycles of burning favouring grasses would spur formation of an Ah horizon, while subsequent stable periods and the

return of forest vegetation would retard its development. Thus an uneven cycle of accelerated and retarded rates of development would occur.

Despite these limitations, a broad age assessment is possible. It is unlikely that even the most long-lived surface on the scarp would have been stable for a period of much more than a few hundred years. In a relative sense, all the soils are short-lived. Absolute ages for the soils depend on a more accurate understanding of the rates of Ah formation than is possible here.

The Farm Side: Terrace Back Sequence

Excavation Units 99, 100 and 101 are a series of contiguous 1 by 1 metre units located at the base of the terrace scarp. Found at an elevation of approximately 398 - 399 m asl, they are southwest oriented on the early spillway terrace. The local slope is generally less than 4° on the terrace, gently declining to the terrace toe, where the slope then increases as it forms the scarp of a lower terrace. Strat Unit 1 is located near the north wall of Excavation Unit 64, an in-filled unit from the 1979 field school terrace excavations.

At least four main depositional units occur in the terrace back units and Strat Unit 1. The uppermost depositional unit consists of clay loam textured materials comprised of reworked lacustrine and till deposits. It is about 45 cm in thickness and, although texturally a single depositional unit, may be the product of a number of separate flow events. Likewise, the top of the colluvial deposit has probably been, in subsequent times, enriched with the addition of slope materials through runoff, creep and other secondary erosional processes. The major portion of the bison bone bed, concentrated at about 25 - 30 cm below the ground surface, is contained in this depositional unit. The second depositional unit, approximately 35 cm in thickness, is also composed of clay loam and is likewise comprised of reworked lacustrine and till deposits from the adjoining lacustrine plain and till scarp. The underlying, third depositional unit is about 30 cm in thickness. It is composed of clay loam, comprised of either a combination of reworked lacustrine and till deposits, or reworked till alone. The fourth or lowermost depositional unit is composed of clay, comprised of reworked scarp till, and is at least 25 cm in thickness.

Considering the moderate slope of the scarp, which is at least partially a function of its age, slump is unlikely to be a significant source of colluvial material eroded onto the terrace. Given also the typically churned, contorted appearance of the lower three depositional layers, their unsorted nature, and the presence of at least one mass movement 'scar' on the upper portion of the scarp, it is suggested that the major form of surface erosion has been, at least in the past, water-lubricated transport of slope materials by earth or mud flows, or solifluction.

Soil formation in the terrace back units is classified as a Cumulic Humic Regosol, characterized by a sequence of buried paleosols. The upper depositional unit has been entirely incorporated into a developing Ah horizon corresponding to the contemporary impact of climatic and vegetative factors on the modern land surface. The Ah horizon has probably been enriched by the addition of organic material from the adjacent slope and if sufficient fresh material is added, soil formation could be retarded. Over time, and if new colluvial material is not added in sufficient quantities to restrict pedogenesis, soil development will extend more deeply into the ground surface, will develop other soil features such as an Ahe horizon, and may incorporate the underlying paleosol.

Buried paleosols have developed in the second, third and fourth depositional units. Signifying separate episodes of soil formation on separate, discrete surfaces, each is characterized by a simple A-C profile. Each soil and, hence, the surface in which it developed was sufficiently short-lived to allow for no more than marginal soil formation. Individually, the paleosols are Orthic Regosols and each has been buried by mass movements from the scarp, thereby illustrating the active instability of the landscape in the recent past. It is possible that a number of other paleosols may extend below the depth of excavation. Figure 22 gives the depositional units, texture and soil horizon pattern in terrace back Unit 99; Figure 23 shows the sequence of buried paleosols.

The Farm Side: Mid-Terrace Sequence

Excavation Unit 125, a 1 x 1 metre unit located 14 m southwest of the terrace back units, 99-101, is approximately equidistant from the scarp base and the toe of the terrace. In other words, it occupies a mid-terrace position. The ground surface slopes gently towards the terrace toe, where it takes on a somewhat "hummocky" appearance characteristic of the dissected terrain commonly seen on the park side of DlMa-1.

At least two depositional units occur in Excavation Unit 125. The upper depositional unit is composed of clay loam, comprised of reworked lacustrine and till deposits, and is about 60 cm in thickness. The second or underlying depositional unit is composed of loam, which is also comprised of

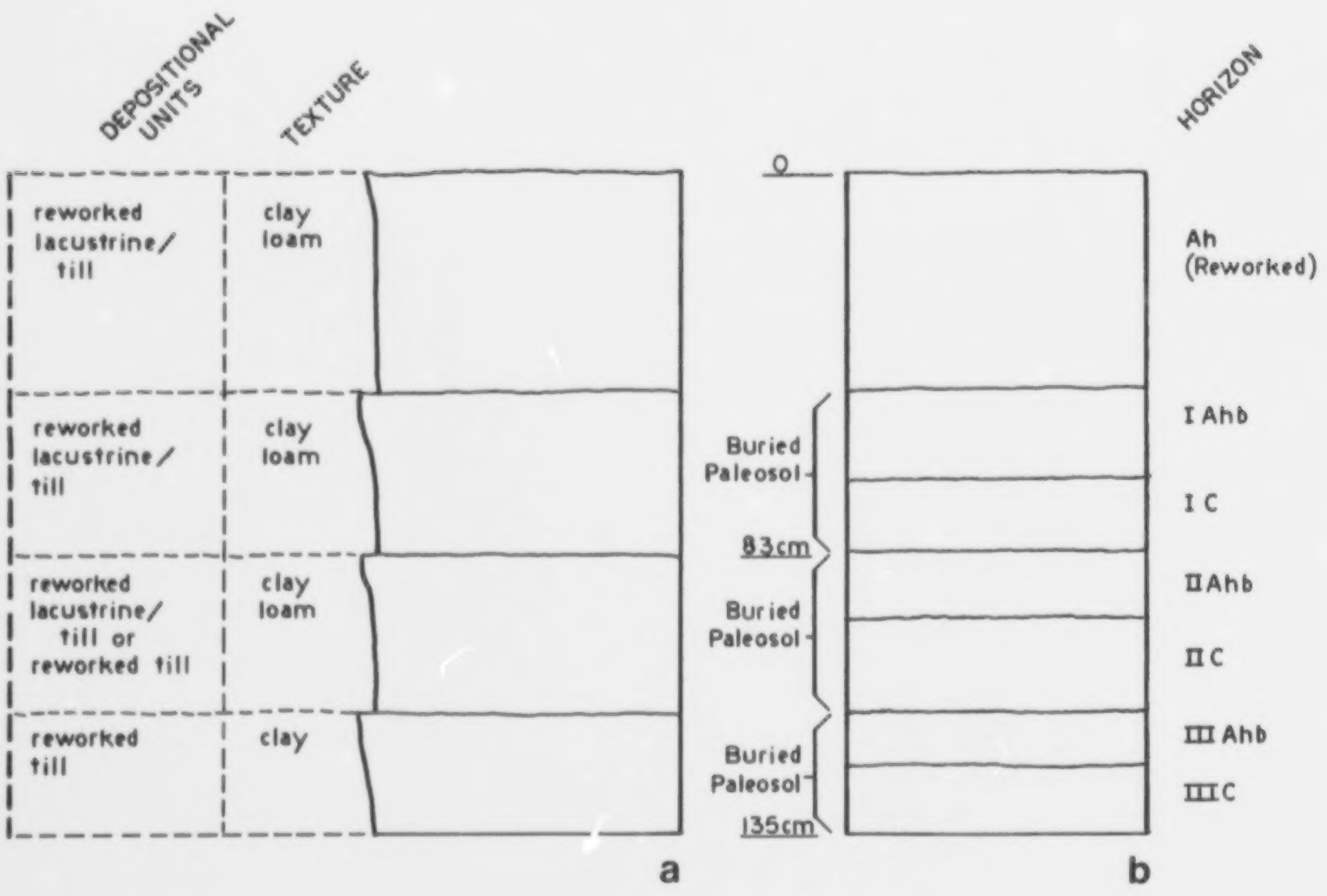

DEPOSITIONAL UNITS
TEXTURE
HORIZON
reworked lacustrine/ till
clay loam
reworked lacustrine/ till
clay loam
reworked lacustrine/ till or reworked till
clay loam
reworked till
clay
0
Buried Paleosol
83cm
Buried Paleosol
Buried Paleosol
135cm
Ah (Reworked)
I Ahb
I C
II Ahb
II C
III Ahb
III C
a
b

Figure 22. Depositional units, texture and soil horizons occurring in Terrace Back Unit 99: (a) gives the depositional sequence and (b) gives the horizon pattern for the Cumulic Humic Regosol formed in the deposits.

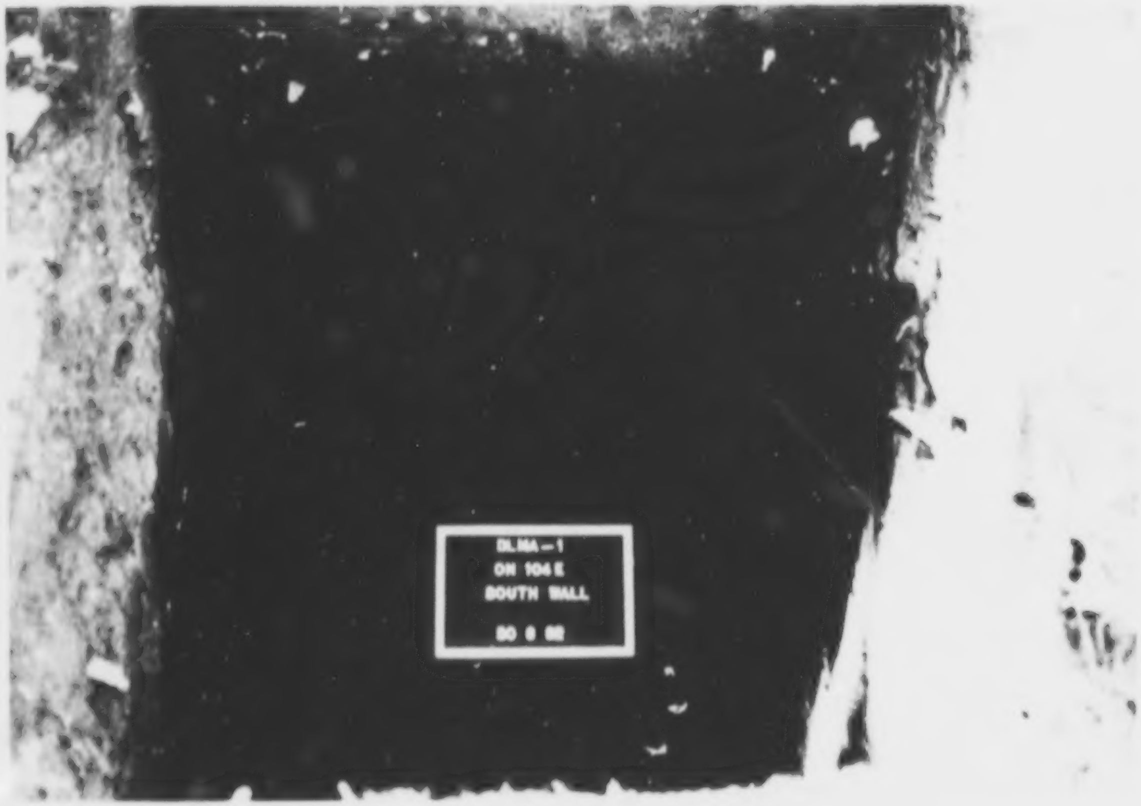

DLMA-1
0N 104E
SOUTH WALL
30 6 82

Figure 23. Sequence of buried paleosols at the base of the scarp. The buried soils indicate former short-lived surfaces which have been buried by fluidized mass movements from the adjoining slope.

reworked lacustrine and till materials. It is at least 63 cm thick and may continue below the depth of excavation.

As in the terrace back units, these depositional units were laid down by a nonsorting depositional process. Considering the well churned, twisted appearance of the deposits, it is suggested that they resulted from the mass movement of fluidized valley top and scarp materials across the terrace face.

Soil formation in the unit is classified as a Rego Dark Gray Chernozem. The profile is characterized by a thick, "graying-out" Ah horizon about 55 cm in thickness. An Ahe horizon, about 15 cm in thickness, has developed beneath the thick Ah. The "grayed-out" or leached appearance of the Ah and the presence of an eluviated Ahe horizon illustrate the impact of changing climatic and vegetational conditions on the developed solum. Initially formed under more arid, grass-favouring conditions, a subsequent climatic shift toward cooler, moister conditions has resulted in a leaching of organic matter from the formerly organic-rich Ah by percolating rain water, producing the grayed appearance of the Ah, as well as the formation of the Ahe horizon. The boundary between the two horizons is indistinct, as the Ah is progressively more leached and the Ahe horizon enlarges.

Two very thick, or possibly a single massive Cca horizon has formed beneath the Ahe horizon. Representing a layer of secondary carbonate enrichment through the dissolution, transport and accumulation of soil carbonates by percolating water, this pedological feature developed under pre-existing arid conditions which are no longer promoted by current climatic and vegetational conditions. It is a relict feature of a pre-existing soil which is no longer in equilibrium with contemporary state factors.

The soil itself is a relict paleosol which is attempting to achieve equilibrium with current climatic and vegetational conditions by altering its soil characteristics in response to the change in state factors. Figure 24 shows the depositional units, texture and soil horizons occurring in Excavation Unit 125.

An attempt to correlate mid-terrace Excavation Unit 125 with the terrace back Excavation Units 99-101 provides a number of apparent contradictions. Firstly, the mid-terrace area is expected to comprise a zone of comparative stability relative to other terrace, scarp and adjoining landscape positions. Sedimentology and cultural stratigraphy, on the other hand, show that the mid-terrace has been unstable in recent times. Because it is an old portion of the landscape and expected to be comparatively stable, the soil developed in the surface should be very old. In fact, soil formation displays a profile composed of very old features, i.e., a sequence of slow-forming Cca horizons, as well as very young ones, i.e., Ah and Ahe horizons lacking a middle range feature such as a B horizon. Furthermore, the two main sources of information concerning past environmental conditions, that is, deposits and soils, directly contradict one another. Depositional history indicates that the mid-terrace surface has been under flow conditions in the recent past and hence has been unstable in recent times. In contrast, pedogenesis indicates that the soil developed in the surface is old and the surface has, therefore, been stable for a long time.

These apparent contradictions can, however, be accommodated if the area is treated neither as old or young, stable or unstable, but as a combination of these conditions separated by the magnitude of reworking processes and differing time frames (Figures 25, 26 and 27). A dynamic model

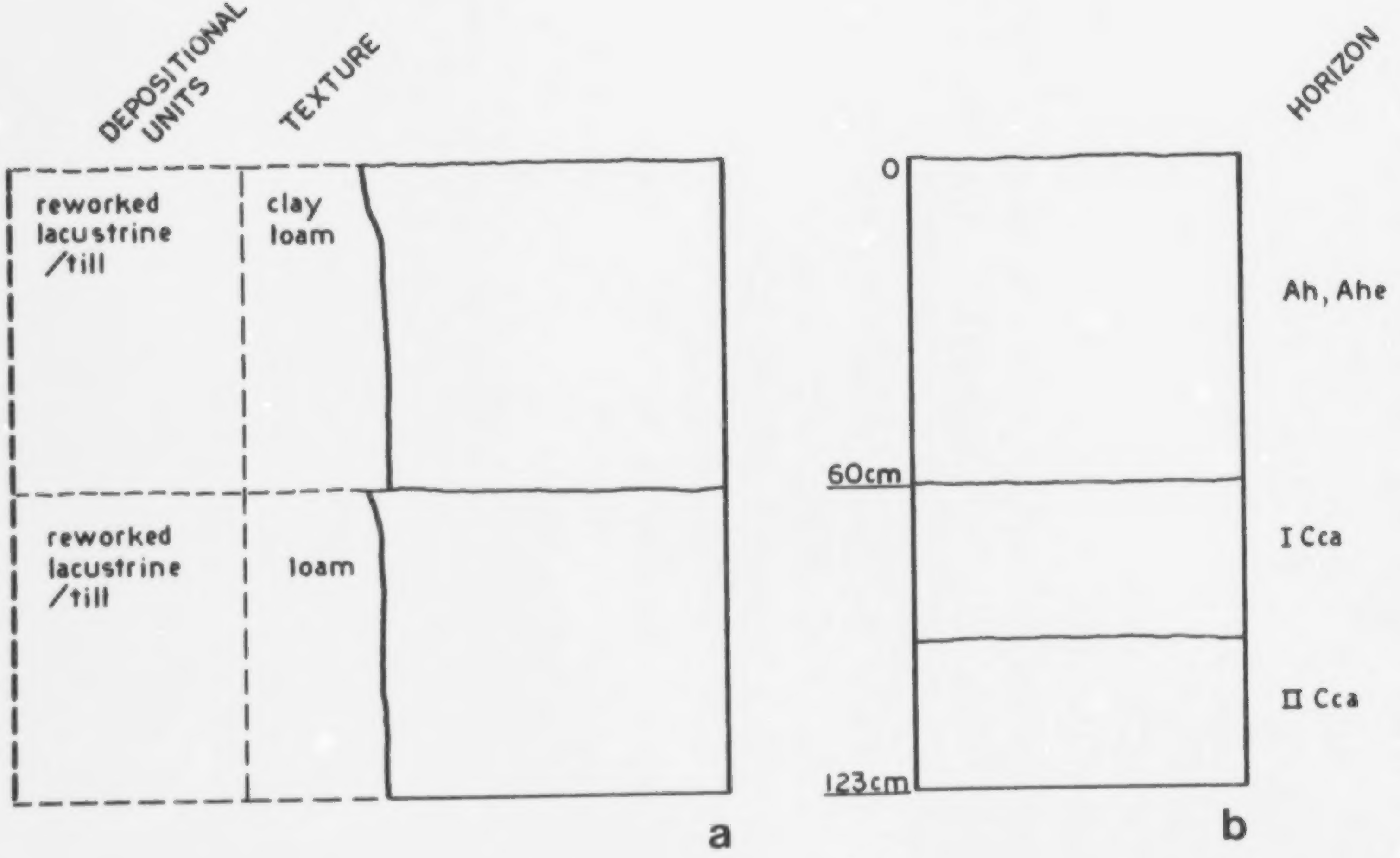

DEPOSITIONAL UNITS
TEXTURE
HORIZON
reworked lacustrine /till
clay loam
reworked lacustrine /till
loam
0
60cm
123cm
Ah, Ahe
I Cca
II Cca
a
b

Figure 24. Depositional units, texture and soil horizons occurring in Mid-Terrace Unit 125: (a) gives the depositional sequence and (b) gives the horizon pattern for the Rego Dark Gray Chernozem formed in the deposits.

TERRACE BACK: EXCAVATION UNITS 99, 100 AND 101

Generally stable though minor additions from creep, runoff, etc.

SOIL HORIZON	DEPOSITIONAL MATERIAL	SEDIMENTARY STRUCTURES	GEOMORPHIC PROCESSES	TIME
reworked, IAhb, Ick -- receives enough runoff materials to inhibit Ahe formation	reworked lacustrine/till materials	contorted or churned, diffuse layers -- poorly defined sedimentary structure	intense solifluction episode or events	600 - 1200 years BP
lower paleosols; IIAhb, IICk; IIIAhb, IIICk -- short lived surfaces	reworked till	contorted or churned, diffuse layers -- poorly defined sedimentary structure	local, minor solifluction events or slump	600 - 1200 years BP or earlier
- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -
more paleosols?			local, minor solifluction events or slump	earlier than 600 - 1200 years BP
	deposits correlating with lower portion of mid-terrace unit -- reworked lacustrine/till		intense solifluction period	?

Figure 25. Soil Horizons, Depositional Materials and Geomorphic Processes for Terrace Back Units. Dashed line shows depth of excavation.

MID-TERRACE: EXCAVATION UNIT 125

Stable since 6000 - 1200 years BP

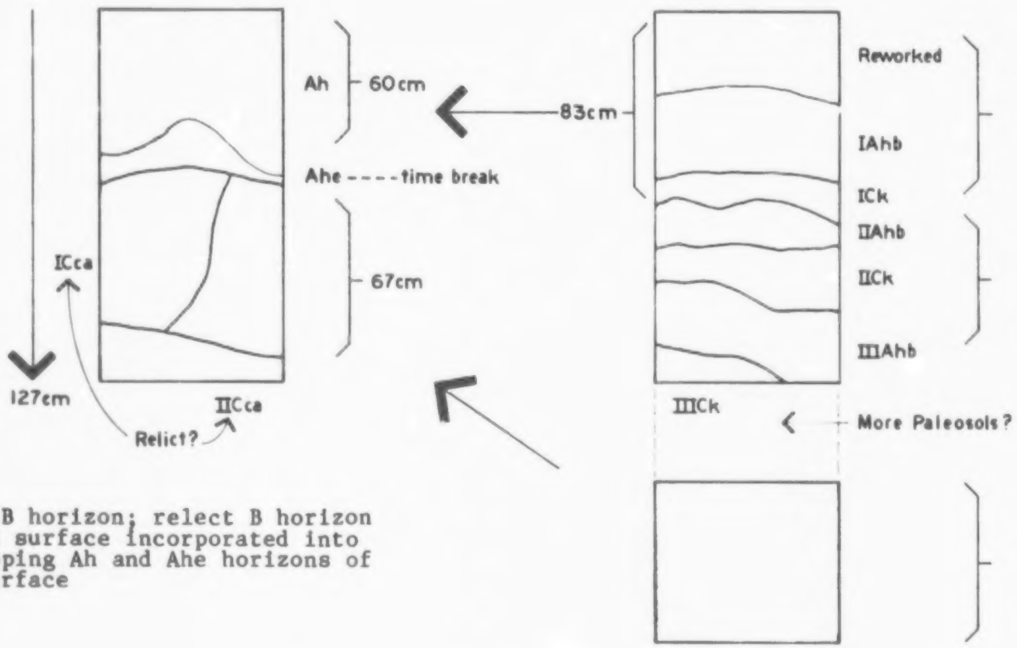
	SOIL HORIZON	DEPOSITIONAL MATERIAL	SEDIMENTARY STRUCTURES	GEOMORPHIC PROCESSES	TIME
Recent	Ah, Ahe -- relatively rapidly developing characteristic -- initially formed under grasses, but now shows environmental shift to cooler, moister conditions -- "graying out" reflects current climatic and forest conditions	reworked lacustrine/till material	lacks stratification -- poorly defined sedimentary structure	recent surface intense solifluction episode -- possibly two separate events	600 - 1200 years BP
Time Break	lacks B -- relict B incorporated into developing new Ah, Ahe -- insufficient time for new B to form			old surface	
Pre-Existing	ICca, IICca -- one or possibly both relict features of pre-existing soil	reworked laucstrine/till material	lacks stratification -- poorly defined sedimentary structure	Related to old surface -- solifluction episode or events	? possibly of Hypsithermal age

Figure 26. Soil Horizons, Depositional Materials and Geomorphic Processes for the Mid-Terrace Unit.

Mid-terrace unit: stable since approximately 600 - 1200 years B.P. Time frame is sufficient for Ah and Ahe formation, but is not long enough for B formation in new surface

Terrace back units: comparatively stable since approximately 600 - 1200 years B.P. Reduced flow activity, though enough modern material is added to surface to retard Ahe horizon formation

homogeneous by process -- major flow events separated by at least one major time break


Ah
60cm
Ahe ----time break
67cm
ICca
127cm
IICca
Relict?
83cm
Reworked
IAhb
ICk
IIAhb
IICk
IIIAhb
IIICk
More Paleosols?

intense flow episode; period of general, high instability

local, minor flow events or slump -- minor periods of instability

lacks B horizon; relect B horizon of old surface incorporated into developing Ah and Ahe horizons of new surface

correlating deposits with mid-terrace area -- intense flow episode; general high instability

Figure 27. Correlation of Mid-Terrace and Terrace Back units.

correlating depositional units, soil formation and geomorphic processes for the mid-terrace and terrace back units is given as follows:

1. The upper depositional units containing the reworked, IAhb and ICk horizons of the terrace back units, 99 - 101, represent a period of intense flow activity during relatively recent times. These correlate with the upper depositional unit of the mid-terrace area, Unit 125, comprising at least one large flow surface. Thickness of the recent flow surface is approximately 83 cm at the terrace back as compared with 60 cm in the mid-terrace unit. The decreasing thickness of the layer laterally across the terrace and the lack of any appreciable lag effect, that is, the deposition of coarser materials at the slope base with subsequent transport of finer materials, agree well with the expected behaviour of unsorted flow-related activity. The lower depositional units containing the underlying paleosols at the terrace back represent localized, minor flow or slump events. Restricted primarily to the slope base, they do not extend to the mid-terrace area.

2. All of mid-terrace Unit 125 is comprised of transported colluvial materials. It is a relatively homogeneous body of depositional materials which, in terms of process, are probably equivalent throughout, i.e., they are a product of flow-related activity. As indicated, the upper 60 cm of depositional materials correlate well with the upper depositional units at the terrace back. At least one major break in the depositional record, however, occurs at approximately the 60 cm level. At this point, the depositional sequence parts company with that of the terrace back, because the

minor, earth flow or solifluction-type episodes affecting the latter area did not extend to the mid-terrace. A major break in the time frames of these two areas occurs, therefore, at the end of the most recent period of intense flow activity. Whereas the terrace back units were acted upon by minor erosional events, the mid-terrace area was experiencing a period of relative stability.

3. The deposits underlying this recent surface addition in the mid-terrace do not, therefore, correlate with those at the terrace back. The entire depth of the latter units, 99-101, below the most recent intense flow-related surface, is comprised of minor solifluction-type events and it is probable that a number of additional paleosols may extend below the three revealed at excavated depth. At an undetermined depth below these, however, a preceding period of intense flow activity will have deposited a sequence of sediments correlating with those beneath the recent surface materials at the mid-terrace. Whereas the terrace back units show periods of both general and localized flow activity, the mid-terrace area would only receive flow materials during episodes of major landscape instability. Therefore, the time break between recent surface additions and the period when the underlying deposits were laid down in the mid-terrace unit represents an interval of general landscape stability.

4. A depositional sequence taking into account separate time frames for deposits occurring beneath the most recent depositional unit correlates well with observed soil features. In the mid-terrace, the sequence of Cca horizons represents very old features. Slowly

developing, they require long periods of stability to form. Furthermore, the appearance of at least two Cca horizons suggest that they developed through a period of climatic change in the past and have been, or are in the process of, readjusting to changing environmental conditions. Their existence through separate climatic intervals is a further indication of antiquity. Possibly originating during the Hypsithermal when warm, arid conditions would favour their formation, the Cca horizons are now readjusting to moister conditions by being driven deeper into the solum. At least one and possibly both Cca horizons are relict features of a pre-existing soil which no longer reflects current environmental conditions. They are old features, relating to a pre-existing surface. This picture of greater age for Unit 125 soil features than found elsewhere on the terrace is lent further support by the well weathered appearance of clasts contained in the sediments.

Ah and Ahe horizons are comparatively fast developing, young features of the soil and have formed in the recent surface deposit. Correlated with Blackduck times, i.e., approximately 600-1200 years BP, this time frame provides a sufficiently long enough period within which the Ah and Ahe horizons could have developed, but may not be long enough for the formation of a B horizon. The relict B horizon in Unit 125, had it existed, would have been a remnant feature of a pre-existing soil developed in the surface below the recent surface addition, and could have been incorporated into the developing A horizons of the modern soil. In this way, the lack of a B horizon would be a function of time. Together with the known time frame in which the Ah and Ahe horizons have developed, this may provide useful information on the rates of soil formation. If this model is accurate, then the Unit 125 profile is a bisequal soil. In other words, it is a soil in which the existing profile is composed of modern features which are in equilibrium with current climatic and vegetation conditions, and old, relict features which developed under different state factors in the past.

5. The comparatively small amount of depositional material overlying the bison bone beds across the entire terrace suggests a general decline in landscape instability during or immediately following Blackduck times and possibly signals a final forestation of the area. Generally stable conditions since this cultural period have allowed the soil to show the full effect of current environmental conditions in the mid-terrace area. The "grayed-out" appearance of the Ah horizon and the formation of an Ahe horizon reflect contemporary climatic and biotic conditions. This has not occurred in the slope base units, 99 - 101, because, although stabilized by forest vegetation, enough modern material is added to the terrace back units through runoff and creep to inhibit Ahe horizon formation.

Flow-related conditions, therefore, probably began prior to Blackduck times, continued through this period and abruptly ended shortly after the most recent bone bed was laid down. The terrace back units show a coherent chronology of almost continuous general and localized flow activity with a decline in erosional processes occurring only in comparatively recent times. The terrace back has, therefore, been unstable for most of its depositional history and is now only relatively more stable than in preceding times. The mid-terrace, on the other hand, has undergone at least one major period of stability within cultural times. Whereas the time or duration of this stability is not known with certainty, it may relate to Hypsithermal times and, hence, the duration of stability would be measured on the order of several millenia. Furthermore, the warm, dry conditions characterizing the thermal optimum would decrease the effect of water-lubricated landslides and other erosional processes, thereby promoting the land surface stability necessary for the formation of this soil feature. With respect to flow conditions, the surface is now stable.

6. In the terrace back units, Blackduck cultural periods are correlated with periods of intense landscape instability. Although land surfaces can be destabilized during natural cycles of drought followed by fire, or winters of heavy snowfall followed by a rapid spring thaw, the strong correlation of landscape instability with cultural periods may suggest a human component accentuating the natural erosional processes. Fires set to drive bison would effectively destabilize the valley slopes, increasing the impact of the erosional processes. It is possible that a movement of bison from the area with the presumed accompanying human migration, or perhaps a type of bison or other resource exploitation that did not involve wide-scale burning, could be responsible for this post-Blackduck increase in landscape stability. A decline in burning

would produce a general increase in the stability of the slopes with subsequent erosional processes limited to smaller-scale flows with accompanying gullying and creep activity.

Once it is assumed that the depositional history of the terrace units dovetails prior to the addition of recent surface material, and that differing time frames apply to the underlying deposits, it becomes much easier to correlate depositional materials with observed soil features. Clearly, however, what is less well understood in this dynamic model is the time element. Whereas stratigraphic relationships and rates of soil formation provide a relative chronology of events and a general impression of age relationships for the various surfaces, the dynamic reworking of the landscape makes depositional stratigraphy and cultural relationships uncertain. While, for example, it is possible to infer that the most recent flow episode occurred during Blackduck times, i.e., the flow layer contains artifacts related to that cultural period and directly overlays a bone bed of the same cultural association, the ages of underlying deposits are not well known. In a relative sense, it is possible to state that the deposits underlying the recent mid-terrace surface materials are older than the sequence of paleosols in the terrace back, because the former area was unaffected by minor slope instability. The more paleosols underlying the excavated portion of the terrace back units, the older the mid-terrace deposits would be.

In terms of rates of soil formation, the Cca horizons of mid-terrace Unit 125 are slow developing, generally requiring several millenia to form under comparatively dry grassland conditions. While a reasonable estimate of age would place its formation in Hypsithermal times, estimations of this kind are not sufficiently precise to allow for accurate correlation of former land surfaces.

Radiocarbon dating is necessary to provide an adequate chronology of the sequence of paleosols in the terrace back units, 99-101, and the lower depositional unit in the mid-terrace area, Unit 125. Absolute dating is of particular importance in the terrace back, because flow surfaces are commonly distorted when they encounter the slope base, causing separate flow layers to appear as a single surface and hence contemporaneous. Alternately, a single flow layer can be distorted to appear as two distinct layers, one overlying the other, thereby appearing to be of different ages. An adequate chronology for these paleosols would also provide at least partial information on the age of the older deposits, which comprise the bottom portion of the mid-terrace unit. Because the latter predates terrace back paleosols, an absolute date would provide a "greater than" age for the older mid-terrace deposit. The mid-terrace can also be dated directly using the secondary carbonates accumulated in the relict Cca horizons. Given, therefore, the intense reworking occurring on past landscapes and the probable effect on cultural materials, the need for strong stratigraphic control and absolute dating is of particular importance.

The Farm Side: Radiocarbon Dates

Three radiocarbon dates were obtained from the farm side of DlMa-1. They are given below:

lower bone bed (Unit 125)	A.D. 910 ± 90 years
vertical bone feature (Unit 102)	A.D. 900 ± 95 years
IIAhb horizon (Unit 99)	B.C. 2250 ± 115 years

The two radiocarbon dates based on bone collagen yield reasonable ages that correlate well with the cultural remains with which they are associated. They fall within the generally accepted range for Blackduck materials, A.D. 800 - 1400. Unlike the ages obtained by bone collagen dating, however, the date obtained for the buried former surface in Unit 99 used humic acid for C^{14} determination and is not likely to be accurate. Neither associated archaeological materials, expected rates of soil formation, nor depositional stratigraphy can support a date 3,000 years greater than the overlying cultural and depositional materials. An early date of this magnitude is not likely to be accurate for the following reasons:

1. Associated Cultural Remains. Contained archaeological materials are concentrated in the Ah horizon of the buried paleosol, with virtually no remains occurring in the underlying Ck horizon. These artifacts are consistent with other Blackduck materials at the site, suggesting that they were deposited on the former surface. Because the organic horizon is poorly developed, the surface is probably not much older than the Blackduck materials deposited on it.

   The depositional unit which contains the IIAhb and IICk horizons is composed of a small solifluction-type flow surface. If the cultural remains were not deposited on the surface directly as previously assumed, but were reworked from a higher position on the adjoining slope, this scenario would still presuppose that Blackduck materials had already been deposited on the slope to be reworked. Under an idealized model for liquified flow, it is theoretically possible for cultural materials to be sorted in a manner suggesting that they were deposited on the surface when, in fact, they were the product of reworking processes. In such a case, the surface would be somewhat younger than the artifacts it contained, because the Ah horizon would have developed after the flow surface was stabilized.

2. Rates of Soil Formation. The buried Ah horizon signifies a short-lived surface. It comprises the organic horizon of a simple A-C profile which lacks more slowly developing features and shows no impact of the then extant environmental conditions. The profile developed in this pre-existing surface had not, therefore, been forming for the long periods indicated by the radiocarbon age of the Ah horizon. In fact, the profile had been at the surface for probably not much more than a few hundred years, as indicated by the marginal degree of Ah formation.

3. Stratigraphy. Because the buried profile is known to be short-lived, that is, it could not have been forming over a period of at least 3,000 years, in order to justify an early date for this surface, it would be necessary to show either a major period of soil formation in more recent times or the buried profile must be separated by a sufficient number of short-lived surfaces from the current surface in order to account for a very long time frame. In fact, nowhere in the profile are these conditions indicated. Depositional units and their contained soils show, rather, a consistent chronology of unstable conditions separated by only short soil-forming intervals. Furthermore, the deposits immediately overlying the buried surface are rich in Blackduck materials and no artifact-sterile or cultural transition zone separates the buried surface from the upper units. An early age for this surface is, therefore, unlikely. The actual age probably falls within early Blackduck limits.

Probable cause for this dating error is contamination of the humic materials by fossil carbonates. The region is very rich in calcareous materials, including both primary and secondary carbonates. These carbonates are water soluble and, given changing climatic conditions over time, will circulate throughout the solum in response to them. If sufficient water is present, old carbonates can be moved upwards in the soil profile during arid periods. Under these conditions buried surfaces can appear to be older than they are in reality.

This information is of interest, because it indicates that the use of humic materials and carbonates may not be generally useful for radiocarbon dating in this area. Under site conditions where strict stratigraphic control and absolute dating are of particular importance, the potential sources of C^{14} information are limited. Bone and charcoal may provide more reliable radiocarbon sources; however, they too, may be susceptible to carbonate contamination. Dating of secondary carbonate accumulations, such as in the mid-terrace unit, may still be valid provided the layers are sufficiently deeply buried to be unaffected by current climatic conditions.

The Park Side: Excavation Units 105 - 110

Excavation Units 105 - 110 comprise a block excavation located between elevations of 383 - 384 m asl in Area Upper B of the park portion of DlMa-1 (Figure 9). The six 1 x 1 metre units are extended parallel to the sloping north valley wall and are situated 10 to 15 m north of Camping Bay 23. Excavation Units 110 and 105 comprise the northern units; 109 and 106 are situated in the middle, while 108 and 107 constitute the southernmost units. They are oriented to the southwest and located in a gently sloping surface of approximately 4°.

Ground surface in the vicinity of the block excavation is uneven and hummocky in appearance, but lacks the well smoothed, rounded appearance typical of the strongly dissected terrain found at upper elevations and in eastern portions of the park area of DlMa-1. As indicated previously, this dissected landscape is a remnant feature of former times, early in the age of the landscape, when gullying activity was at a peak and was among the dominant landscape shaping factors. Tree cover is mainly young with numerous stumps apparent. An initial appraisal of the immediate ground surface suggests, therefore, that the land surface has been altered in recent times, probably in connection with park construction and landscaping activities. Because the excavation units are situated directly north of a camping bay and located close to a washroom facility, it is expected that the ground surface has been modified by clearing and leveling. Therefore, the current land surface is not the same as that which existed prior to park related activities (Figure 28). A small erosion gully occurs about 7 m west of the units.

Although comprising a block excavation, the western excavation units may be separated from the eastern ones on the basis of differences in the erosional processes operating over the excavation area, as well as the type and age of the soils developed in the buried paleosurface. Two main depositional units occur in this excavation area.

Perhaps the most prominent feature occurring in the block excavation is the presence of a buried, relict erosion gully. Bisecting Units 108, 109 and 110, a small gully has carved a distinctive bowl-shaped channel into the valley slope. A remnant feature of a pre-existing landscape, it is similar to the large scale gullying action responsible for the dissected terrain common to this portion of the spillway slope. It is, however, both smaller and

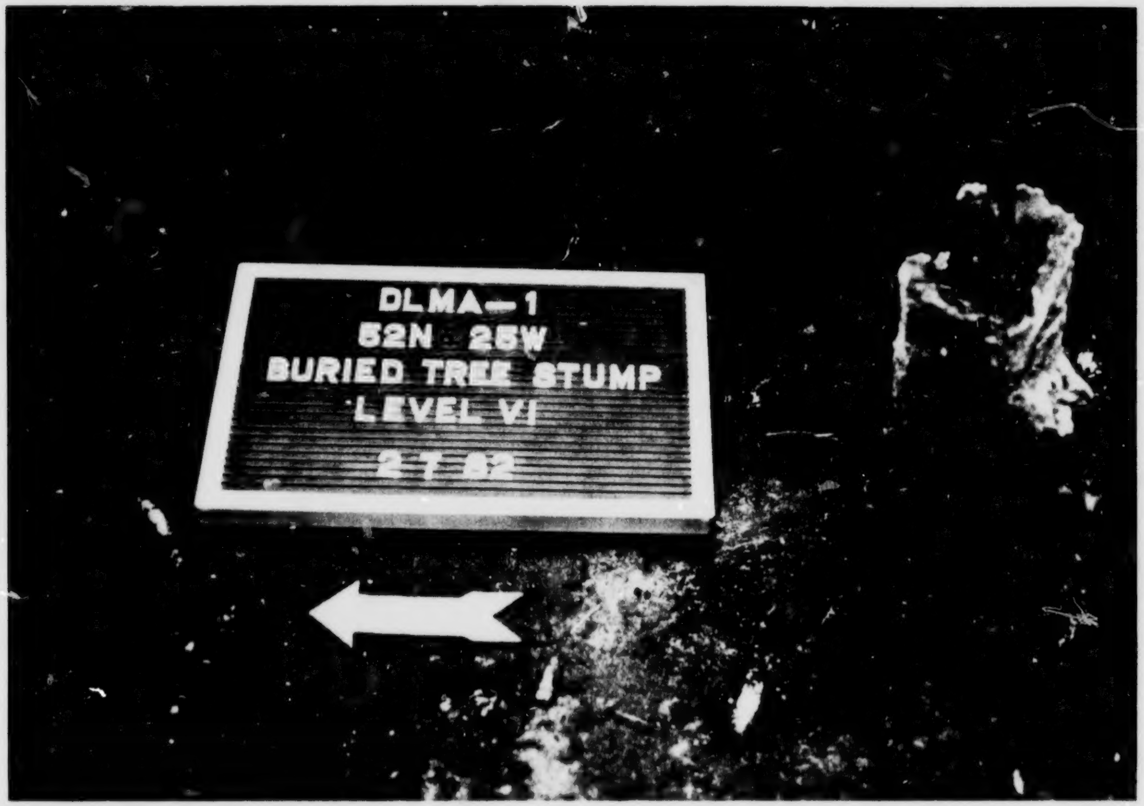

DLMA—1
52N 25W
BURIED TREE STUMP
LEVEL VI
2 7 82

Figure 28. Buried tree stump in Unit 52N 25W. The results of modern landscaping in Grand Valley Park are illustrated.

probably more recent than those runoff channels which sculpted the resistant hillocks populating the slope. When the gully was still active, it deposited coarse materials in the southernmost portion of Unit 108. This concentration of fine to medium pebbles and stones, absent in other portions of the buried channel, suggests that the sediment-laden runoff waters had encountered more level or depressional terrain on an earlier land surface and were depositing coarser materials in response to a decrease in flow velocity. Though now obscured by subsequent flow activity and by recent park modifications, it is possible that the more level surface encountered by the runoff waters may have once comprised a small bench of the receding spillway which was later used as a convenient place in which to locate one of the park roads.

In the western excavation units, the overlaying depositional unit consists of a heterogeneous mix of sandy, silty and clayey materials, but contains only small quantities of coarser textured materials, ie., pebbles and stones. Sedimentological analysis shows that the depositional material is unsorted and, therefore, the erosional process responsible for its deposition is likewise an unsorted one. The transported material consists of till eroded from the north valley wall and may also contain reworked lacustrine sands from the lacustrine plain which adjoins the valley top. The unsorted nature of the depositional process, in combination with the characteristically churned, distorted appearance of the depositional unit indicates that the depositional mechanism comprised a type of unsorted flow. This water-lubricated mass movement layer, had, therefore, moved from a destabilized portion of the land surface higher on the slope, overriding and burying the previously active gully. The fluidized nature of the flow is evident in the distinct rippling of the oozing mass as it encountered and was forced over the concentration of coarse pebbles and stones deposited earlier during the active phase of the gully. Rippling is most evident in the southwest corner of Unit 108, where the greatest concentration of gully-deposited pebbles and stones occurs. The gradual increase in the amount of flow materials toward the base of the three western units, like the accumulation of coarse materials from the pre-existing gully, suggests that the flow surface had reached level terrain and was accumulating as a result. Filled by this flow surface, the gully ceased to function as a channel for runoff waters and, as a result of this and possibly subsequent flows, was effectively stabilized forming a new ground surface (Figure 29).

In the eastern excavation units, sedimentological analysis of the lower depositional unit indicates that the type of depositional process was similar to that which buried the gully in the western units. The depositional process in both areas is, therefore, a function of fluidized flow. However, this does not mean that they are necessarily a part of the same flow surface, or that they were laid down at the same time. Pedological information, as will be shown, indicates they are not part of one flow surface and rather, that these flow surfaces occurred at different times.

The upper and most recent depositional unit consists of undifferentiated sandy, silty and clayey materials with abundant stones and coarse sand lenses. These depositional materials uniformly overlay the paleosurface which extends across the western and eastern units. The lack of any soil development indicates that this deposit and the surface it now forms is of very recent age. As such, it probably constitutes an overburden comprised of artificially redeposited surficial materials. Park construction and landscaping activities have redistributed surface deposits and soil

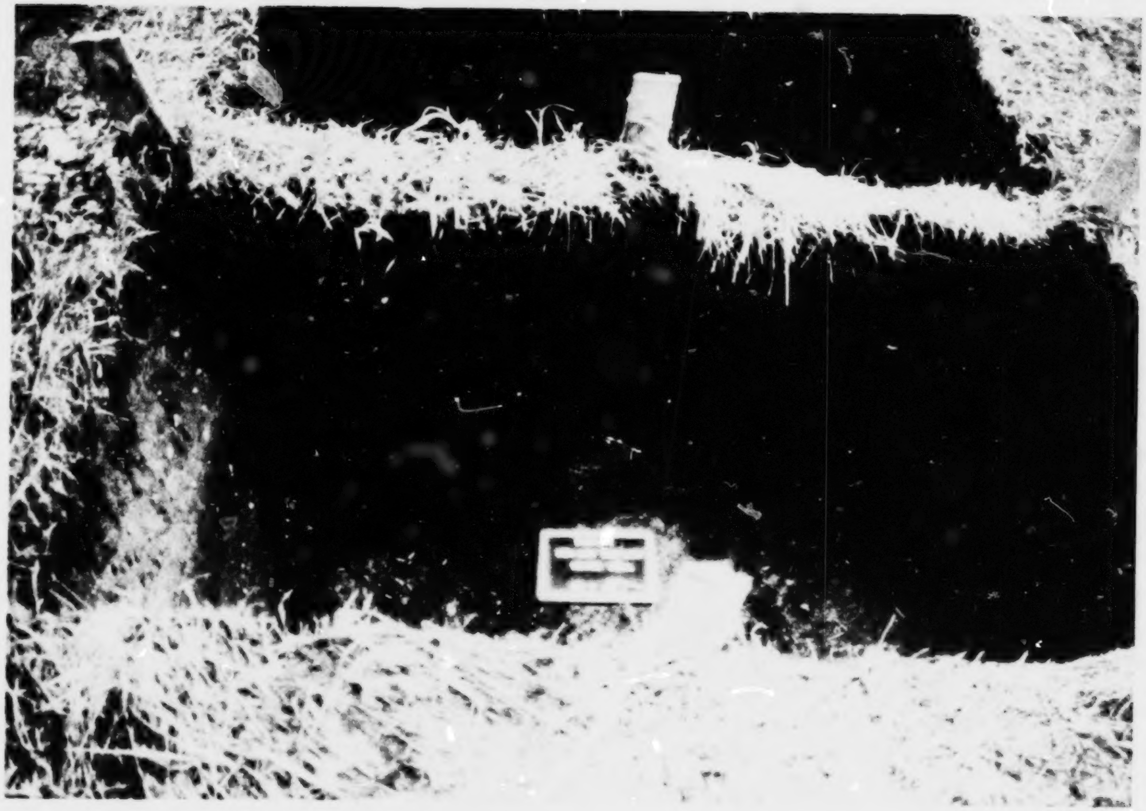


Figure 29. Infilled gully. This feature occurred in the western portion of a block excavation in Units 52N 25W and 52N 24W.

materials, likely adding sandy and gravelly materials to the overburden from the neighbouring road and camping bay. The latter materials were used to surface road and bay areas and have no doubt contributed to the heterogeneous mix of materials apparent in this surface layer. Gouging of the paleosurface by heavy machinery has contributed to the uneven appearance of the former surface, some of which may have been entirely removed by modern activities.

Soil formation in the western portion of the buried paleosurface, that is, in the infilled gully part of the paleosurface, is a Humic Regosol. Developed in the pre-existing surface, it is now covered by the modern park-related deposits. Similar to Orthic Regosolic soils formed on other landscape positions, it differs only in the degree of Ah horizon formation. Here, the organic-enriched A horizon is slightly better developed than in the Orthic Regosolic soils. However, like these marginally developed soils, a Humic Regosol lacks other genetic features. It is, therefore, a poorly developed soil formed in a comparatively recent and short-lived surface.

The soil developed in the eastern portion of the buried paleosurface is a Rego Black Chernozem, which is distinguished from the short-lived soils in the western units by the presence of a distinctive layer of secondary carbonate enrichment. Forming a discontinuous, uneven horizon between the buried Ah and parent Ck horizons, the appearance of this zone of carbonate accumulation signals a longer-lived soil occurring in a surface which was stabilized earlier than its western counterpart. Because the formation of carbonate layers is a slow process relative to that of Ah horizons, a longer time frame is indicated.

Whereas sedimentological analysis shows that the surfaces in which both soils have developed were laid down as a product of earth or solifluction-type flows, the apparent differing ages of the soils suggests that the flow surfaces were not laid down at the same time. A probable scenario for such an occurrence is given as follows. Originally a single flow surface covered the entire excavated portion of the slope. Subsequent soil development in the stabilized surface saw the formation of Chernozemic or at least Humic Regosolic soils in both the eastern and western portions of the block excavation area. The type of soil developed at this time was a direct function of the time available for its formation. In later times, the channeling of surface waters created a small gully which carried away the pre-existing soil in the western units. As a result, only the paleosurface in the eastern units, and the Chernozemic soils developed in them were left intact. Subsequent infilling of the gully provided a newer surface in which pedogenesis could take place. This flow or flows could have proceeded as a small tongue moving down the erosion channel or, if it was a larger flow surface, could have partially overridden the adjacent paleosurface. The exact procedure is not known, however, because modern landscaping has gouged the pre-existing surface and undoubtedly removed much of the surface materials. The soil developed in the eastern part of the paleosurface, therefore, predates not only the soil in the western portion, but is older than the gully as well. The greater age of this surface provides a longer-lived, stabilized surface on which cultural materials could be deposited.

Figure 30 illustrates the dynamic sequence of events responsible for the differing ages of the soils developed in the paleosurface. Figures 31 and 32 give the depositional units and soils occurring in the block excavation.

In summary, an examination of the depositional units, sedimentary structures and soil formation in this block excavation provides the following significant points:

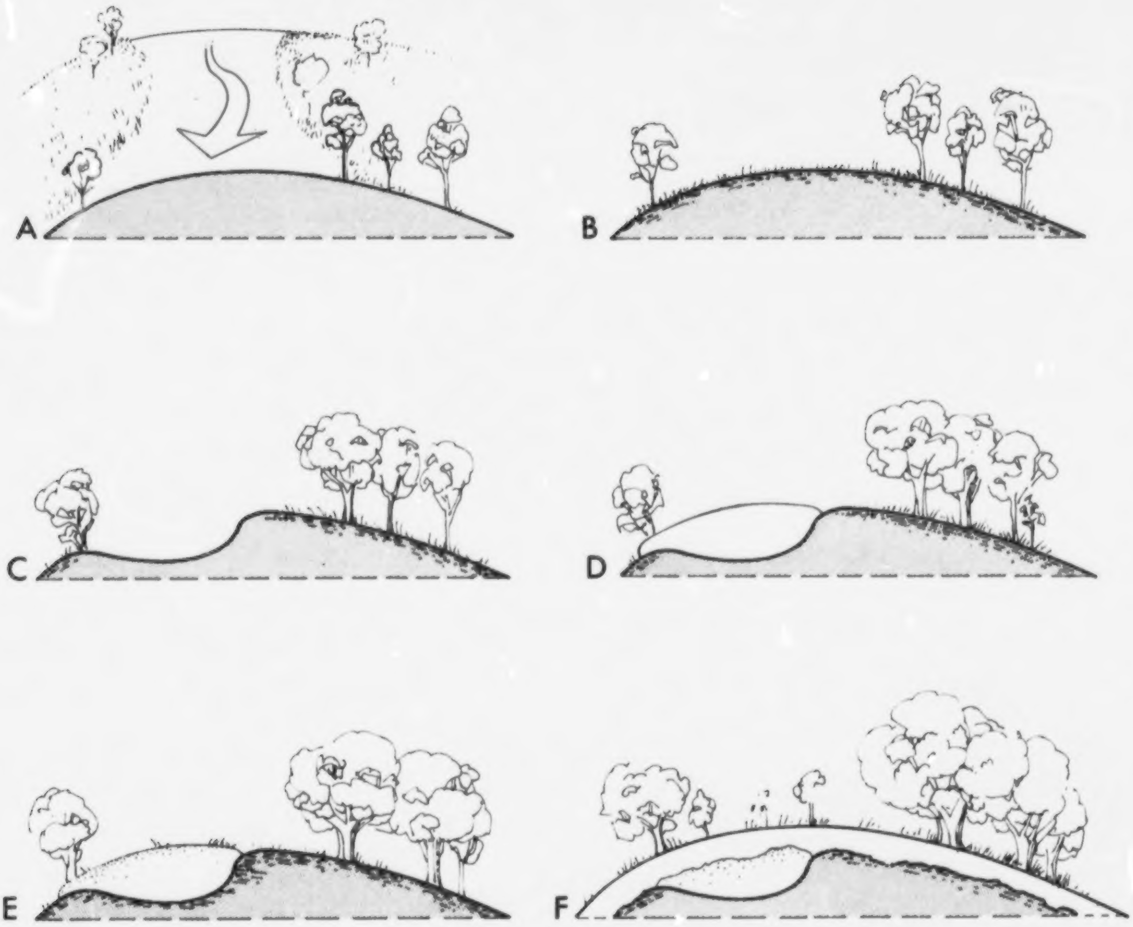


Figure 30. Landscape evolution and soil relationships in Excavation Units 105 - 110. (A) A single flow surface covers the pre-existing terrain. (B) Soil formation takes place in the stabilized surface; Regosols or Chernozemic soils begin to develop. (C) Gully erosion carves a channel in the western portion, carrying away the developing soils. (D) A later flow surface buries the channel. (E) Subsequent stabilization of the more recent flow surface allows soil formation to begin again. Humic Regosols form in the fresh surface. Rego Black Chernozems have developed in the older surface. (F) Park modifications have gouged the paleosurface and buried it under redeposited surface materials.

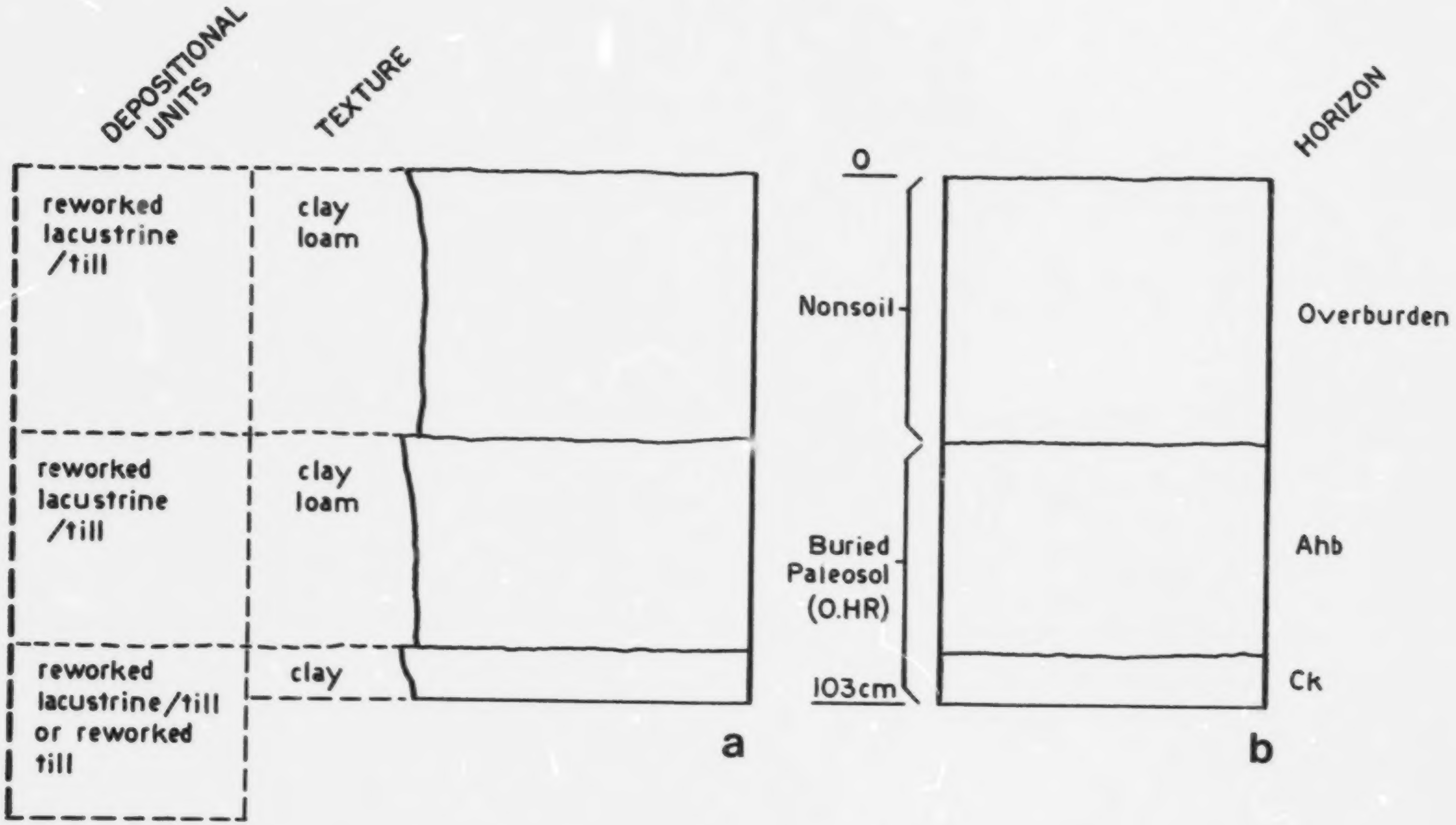

DEPOSITIONAL UNITS
TEXTURE
HORIZON
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
reworked lacustrine/till or reworked till
clay
a
0
Nonsoil
Buried Paleosol (O.HR)
103cm
Overburden
Ahb
Ck
b

Figure 31. Depositional units, texture and soil horizons occurring in Unit 108. It is representative of units in the western portion of the block excavation. (a) gives the depositional sequence and (b) gives the horizon pattern for the buried Humic Regosol formed in the paleosurface beneath the recent overburden.

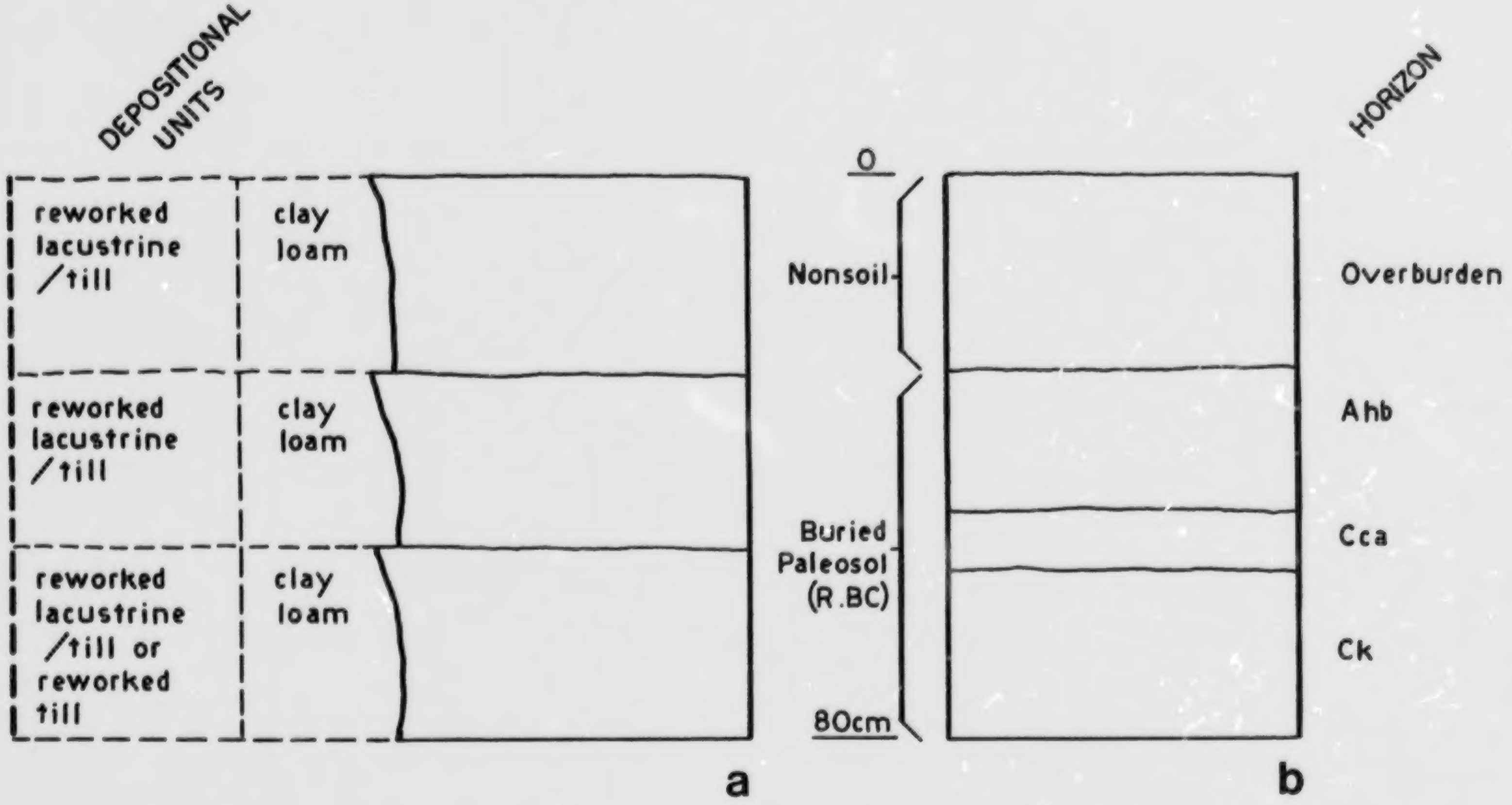

DEPOSITIONAL UNITS
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
reworked lacustrine /till or reworked till
clay loam
a
0
Nonsoil
Buried Paleosol (R.BC)
80cm
HORIZON
Overburden
Ahb
Cca
Ck
b

Figure 32. Depositional units, texture and soil horizons occurring in Unit 105. It is representative of units in the eastern portion of the block excavation. (a) gives the depositional sequence and (b) gives the horizon pattern for the buried Rego Black Chernozem formed in the paleosurface which is now covered by modern overburden.

1. The earliest geomorphic event to affect this landscape position is, to excavated depth, the deposition of a single earth or solifluction-type flow layer. It remains as the bottom or earliest depositional unit in the eastern excavation units.
2. A small, buried erosion gully bisects the three western excavation units. Eroded into the surface of the former flow surface, this relict gully carved a distinctive channel in the face of the north valley slope and removed the previously deposited flow-related materials.
3. A subsequent flow episode buried the once active gully under reworked till-related materials. The unsorted nature of this deposit, the wavy churned appearance of the lower boundaries, and the characteristic rippling effect as the depositional material overrode the concentration of coarse pebbles and stones at the base of the western units all indicate a type of fluidized flow. In the western units, this later flow surface comprises the lower or earliest depositional unit.
4. The upper depositional unit uniformly overlays the previously deposited flow layers. It occurs as a result of the redeposition of surficial materials through park-related construction and landscaping activities. As such, it is comprised of overburden and constitutes a nonsoil. The lack of any indication of soil development indicates that this surface is unlikely to be any older than the age of the park itself.
5. In the western units, Humic Regosolic soils have developed in the buried flow surface which has filled in the former gully. In the

eastern units, Rego Black Chernozems have developed in the earlier flow surface. The presence of comparatively slow forming calcium carbonate layers, Cca horizons, in the latter sola indicate that these soils have been developing over a longer time frame than their adjacent counterparts. The longer time frame, in turn, implies a longer period of stability over which pedogenic processes could operate. Since sedimentological analysis shows that the parent materials for both soils are texturally similar and the depositional process in both cases is a nonsorting one, the parent materials for both soils were deposited by similar processes but at differing time periods. The flow surface in the eastern units, therefore, provided a comparatively stable surface in which soil formation could take place before that of the western units. Consequently, the two soils are of different ages, the Chernozemic soils being older than the neighbouring Regosolic soils. Although of differing ages, the two soils have formed in a continuous paleosurface which has been stabilized longer than the overlaying, modern surface.

6. As rates of soil formation are not a well understood aspect of pedogenesis and can vary widely with variations in the state factors over comparatively small distances, only a general estimate of the ages of the two buried soils is possible. Similar to other Regosolic soils occurring on different landscape positions, the only developmental feature is the organic-enriched Ah horizon. Though the organic horizon is slightly better developed in Humic Regosolic than in Orthic Regosolic soils, the time frame required for its formation is still likely to be measured in terms of hundreds rather than

thousands of years and, like the surface in which it has developed, is unlikely to greatly predate the Blackduck cultural materials it contains. The Cca horizon of the Chernozemic soils is a slower developing pedologic feature whose rates of formation are, on the other hand, sometimes measured in terms of millenia. An educated guess would give a minimal age of the soil as at least 2,500 years. Indicative of a longer-lived surface, it therefore provides better potential for the recovery of older and *in situ* cultural remains.

7. Modern landscaping has much altered the pre-existing terrain. The paleosurface is somewhat more steeply sloping to the south than is its modern counterpart and the accumulation of gully-deposited coarse materials at the base of the western units, as with the increasing thickness of flow surfaces downslope, suggests that the terrain was becoming more level immediately below the block excavation. It is possible that the more level land surface once comprised a minor spillway bench that has since been modified by park-related activity and converted to a roadway.

The Park Side: Excavation Units 111 - 118

Located at an elevation of approximately 377 m asl in Area Upper B on the park side of DlMa-1, Excavation Units 111 - 116 comprise a block excavation of six 1 x 1 metre units extended parallel to the gently sloping north valley wall. The units are oriented to the southwest and occur on a modestly rising slope of about 3°. They range from 5 - 16 m north of Camping Bay 6 and are located near a drainage channel which borders an access road leading to campsites at higher elevations. This access road, in turn, borders another larger drainage channel and the TransCanada Highway to the west. Like the ground surface around Excavation Units 105 - 110, the immediate landscape shows an uneven, hummocky appearance which suggests a reworking or modification of the ground surface in comparatively recent times. Also associated are large till-related boulders occurring at ground surface. It is expected that the modern land surface has been modified by landscaping, as well as park and highway construction activities.

Three depositional units occur to depth of excavation. The uppermost is composed of undifferentiated clay loam textured materials, fine- to medium-sized pebbles and stones, and intermittent sandy lenses. Although the unsorted nature of the deposit makes it indistinguishable from a form of unsorted fluidized flow, it lacks any expression of soil development and is, like the soil it contains, of very recent age. The recent age of the deposit, combined with the decline of flow-type activity following Blackduck times witnessed elsewhere, suggest that the deposition probably resulted from contemporary overburden and is a nonsoil. It forms a comparatively thin veneer of artificially redeposited soil and till-related depositional materials over the underlying depositional sequences. Like the overburden which covers the paleosurface in Excavation Units 105 - 110, it is unlikely to be any older than the park itself.

The underlying or second depositional unit consists of a comparatively thin layer of unsorted clay loam materials and includes a few fine- to medium-sized rounded pebbles and stones. The unsorted nature of the depositional process in association with the wavy, churned appearance of the layer suggest a type of fluidized flow similar to that common to other depositional units on other portions of the park landscape. As such, it comprises a small flow layer of reworked till-related materials representing a subsequent reworking of previously eroded and transported upper elevation materials.

The bottom or earliest depositional unit is also composed of clay loam textured materials. Fine- to medium-sized rounded pebbles and stones are common and increase in quantity with depth. Sedimentological analysis and sedimentary structures indicate a depositional process similar to the overlying deposit. A thick flow surface, it constitutes the major portion of the unit depth and signifies a major flow event.

A Humic Regosol has developed in the lowest depositional unit. Formed in the lower flow layer, it reflects the expression of the soil forming factors of this pre-existing surface. Consequently, it comprises a buried paleosol developed in a now buried paleosurface. Like other Regosolic soils, it is comprised of a simple A-C profile. Although the Ah horizon is thick and well developed relative to the more recent, upper paleosol and to Regosolic soils occurring elsewhere on the park landscape, the Ah horizon lacks sufficient structural development to be classed as a Chernozemic Ah. In other words, it had not had sufficient time to develop into a Chernozemic soil and is, therefore, a short-lived soil.

An Orthic Regosol has formed in the small flow layer overlaying the lower paleosurface. Also representing a former surface, this paleosurface has since been covered by overburden. Aside from the poorly expressed organic horizon, it lacks all other pedogenic features and is even less developed than its earlier counterpart. It is, therefore, even more short-lived than the pre-existing soil.

As indicated, the overburden constitutes a nonsoil and shows no diagnostic pedogenic features. It thereby shows no impact of the climatic and vegetational state factors and is characteristic of surfaces which have been in place for only very brief periods of time.

As a whole, the depositional sequences and the soils found in them present a picture of active landscape instability broken by intervals of briefly stabilized land surfaces. Age assessment based on degree of Ah horizon formation in the Regosolic soils suggests that neither surface has been sufficiently long-lived to be measured in terms of more than hundreds of years. As such, the soils are unlikely to be greatly older than the artifacts they contain. The Humic Regosol in the earlier flow surface had been developing longer relative to the marginally formed Orthic Regosol in the succeeding flow layer. A time frame of a few hundred years is probably adequate to allow for the marginal Ah horizon seen in the latter, whereas a somewhat longer time frame is necessary to account for the degree of development in the former. Neither soil, however, displays other, more slowly developing features which would require ages of much more than a few hundred years.

Figure 33 gives the depositional units and soils occurring in this block excavation.

Excavation Units 117 and 118 lie west of the main block excavation and border the southern edge of 1981's 2 x 2 metre excavation Unit 87 (see Figure 9). Located near block excavation 111 - 116, the main depositional units and soils in these two units are much the same as those occurring in the block excavation.

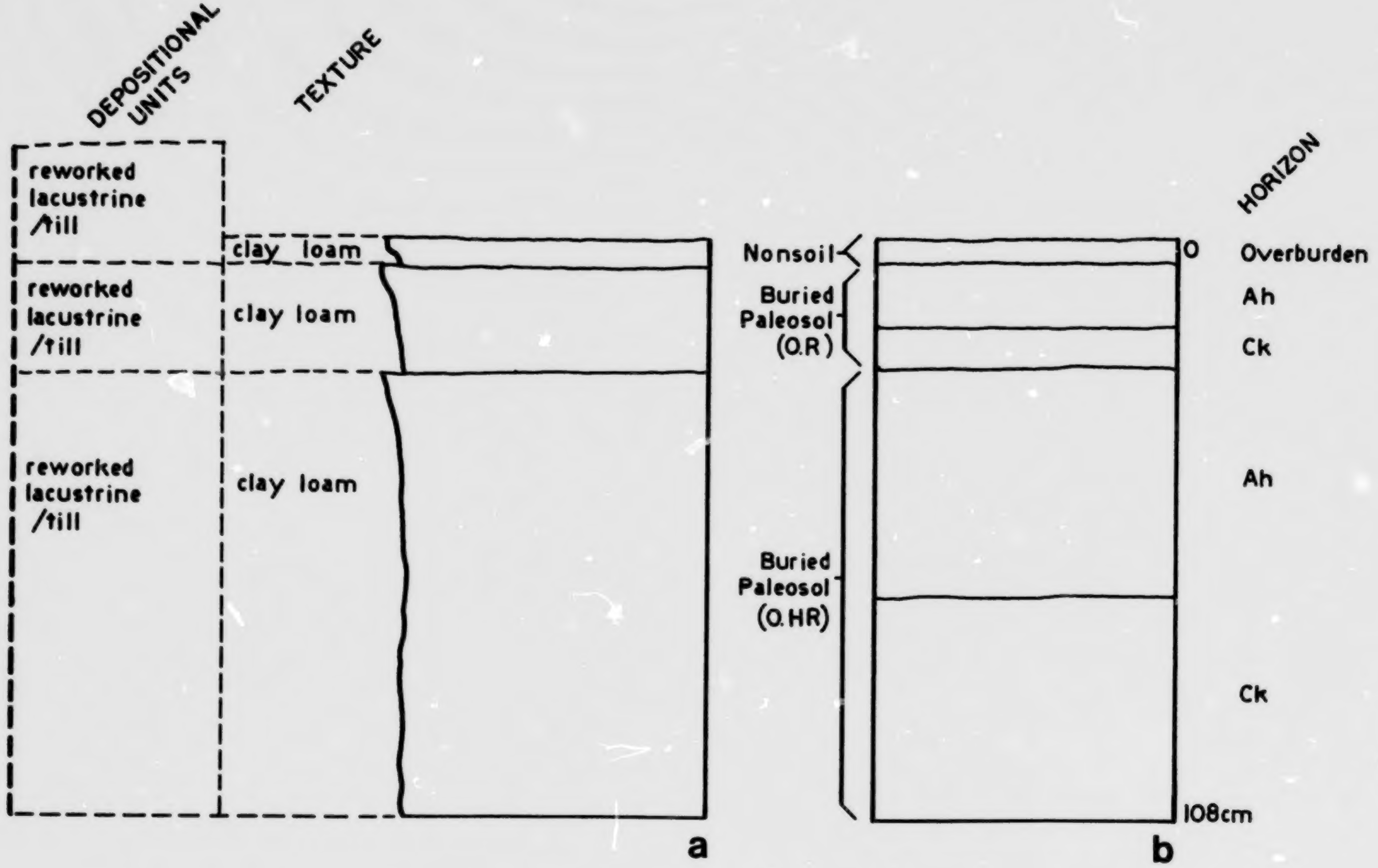

DEPOSITIONAL UNITS
TEXTURE
HORIZON
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
reworked lacustrine /till
clay loam
a
Nonsoil
Buried Paleosol (O.R)
Buried Paleosol (O.HR)
0
108cm
Overburden
Ah
Ck
Ah
Ck
b

Figure 33. Depositional units, texture and soil horizons occurring in Unit 116. (a) gives the depositional sequence and (b) gives the soil horizon pattern for the buried Orthic Regosol (upper paleosol) and the buried Orthic Humic Regosol (lower paleosol).

Similarity of grain size distribution in the earliest depositional unit in the block excavation with that in Units 117 and 118 suggests that the major flow event represented by this deposit is the same in both areas. Both deposits, in other words, constitute portions of the same water-lubricated mass movement and, following stabilization of the large fluidized mass, it formed a continuous new surface covering at least the site area between Units 117 and 118 and the block excavation. Subsequently, in both areas, the paleosurface was covered by succeeding smaller-scale flows.

Although it is possible that the small flow layers overlaying the major flow layer are also the same in both areas, the Ah horizon formed in the paleosurface of the small flow layer in Units 117 and 118 has incorporated the entire deposit. There, the IAhb had developed throughout the deposit and may have begun to incorporate the underlying, earlier IIAhb horizon into its forming solum. In the block excavation, the soil formed in the small flow layer is less well developed, showing a marginally developed IAhb horizon as well as an undeveloped parent Ck horizon. It is possible, therefore, that the two small flows comprise separate, discrete flow layers indicative of minor flow activity and that the flow layer in the two western units occurred earlier than that in the block excavation. This would account for the greater degree of development in the soil formed in the small flow layer in Units 117 and 118 and therefore, indicate a longer time frame in which pedogenesis could take place. Orthic Humic Regosols have formed in the two paleosurfaces of Units 117 and 118.

Park Side: Excavation Units 119 - 124

Excavation Units 119 - 124 comprise a block excavation located at an elevation of approximately 372 m asl in Area Upper B of DlMa-1. They occur as six 1 x 1 metre units extended perpendicular to the slope of the north valley face. Excavation Units 121 and 124 comprise the westernmost units; 120 and 123 are the middle units, while 119 and 122 are the easternmost units. They are situated on a gently rising slope of about 3° approximately 10 m north of Camping Bay 1 (see Figure 9). Unlike the terrain surrounding the other block excavations on the park side of DlMa-1, the ground surface is comparatively smooth and lacks the "hummocky" appearance characteristic of the latter areas. This suggests that less landscaping has occurred in the area, probably because the ground surface was comparatively level prior to the park construction. Located at a lower elevation than the other block excavations, this area is further away from the steeply sloping valley wall as the land surface grades toward the level alluvial bottom land. The rolling terrain, typical of uneven till distribution and subsequent dissection of fast-flowing runoff waters, is still evident though less severe than at higher elevations.

Two depositional units occur in the westernmost four Excavation Units 121, 124, 120 and 123, whereas three depositional units are revealed in Unit 119 and along the north wall of Unit 122.

In the former group of units, which comprises the bulk of the excavated area, the depositional sequence consists of a thin, modern overburden atop a thick flow layer. The upper depositional unit is composed of a layer of recently resorted road bed materials. Transported from the adjoining access road, the road fill materials are light in colour and consist mainly of fine-textured silts and sands with lenses of gravelly material. The appearance of numerous thin laminae composed of various texturally sorted sediments indicates the sorting action of water and wind. Fast-flowing runoff waters would account for the major share of the downslope transport of road bed materials.

The underlying depositional unit, comprising the bulk of the excavated unit depth, is composed mainly of clay loam with frequent small, rounded, calcareous stones. Sedimentological analysis indicates that the method of deposition is an unsorted one and is, therefore, likely to be similar to the earth or solifluction type of flow comprising the dominant form of landscape alteration seen elsewhere on the site. The flow layer consists of reworked till materials. With the exception of the thin veneer of runoff-carried road fill sediments capping this flow layer, the deposit comprises a single flow extending to at least the depth of excavation. It constitutes, therefore, a single, major flow event.

No indication of soil development is apparent in the overburden. It lacks both A and B horizons and, in particular, lacks the relatively fast developing Ah horizon common to even the most short-lived Regosolic soils. The overburden, a nonsoil, is consequently of very recent age.

The underlying paleosurface, that is, the pre-existing surface of the large flow layer, contains a Rego Black Chernozem. The Ah horizon is thick, very black and shows a well developed blocky, columnar structure. The Ah horizon grades into the calcareous parent horizon, the Ck horizon, forming an indistinct boundary. The Ck is very hard, massive, and contains numerous fine- to medium-sized rounded calcareous stones. The rich, well developed Ah horizon, and especially, the well defined columnar structure of the A horizon suggests that the soil is longer-lived than many of its landscape counterparts and that, in turn, the paleosurface in which it has formed had been stabilized earlier than in adjoining landscape positions.

Along the eastern portion of the block excavation, in Excavation Units 119 and along the north wall of Unit 122, a third depositional unit is present. The upper depositional unit consists of the same overburden veneer covering the pre-existing deposit in the western units. It forms a continuous layer capping earlier deposits in both western and eastern portions of the excavation.

These modern runoff products cover a relatively thin second depositional unit. Composed of primarily clay loam textured materials with frequent small pebbles and stones, sedimentological analysis and sedimentary structures indicate that the deposit is a small flow layer comprised of reworked slope till materials. The thickness of the small flow decreases from Excavation Unit 119 to 122, that is, from north to south, and is at maximum thickness along the north wall of 119. This suggests that the eastern units have been located along the edge and near the end of the small flow.

This small flow layer, in turn, overlays a third depositional unit. Comprising the major share of the excavated depth of the unit and continuing to at least unit depth, it also shows an unsorted type of depositional process characteristic of an unsorted fluidized flow mechanism. As such, it forms a flow layer similar in type to others commonly seen as depositional units in other landscape positions. As a single large flow layer, it signifies a major flow event. Furthermore, the distribution of individual mineral textural classes within the flow suggests that it is a continuation of the large flow layer found in the western units. Similar to the latter units, the deposit is composed of clay loam derived from the reworked till of the valley wall.

As indicated, the overburden in these units is a continuation of that occurring in the western units and, like those units, is a nonsoil. It is of very recent age and shows no impact of climate or vegetation on the deposit.

A Humic Regosol has developed in the small flow layer. The Ah horizon is slightly better developed than in Orthic Regosolic soils. However, the colour of the organic-enriched horizon is very dark gray compared with the very black colour of the buried Rego Black Chernozem located in the western units. Likewise, the soil structure of the Ah horizon here is weakly developed in contrast to the well expressed blocky, columnar structure of the A horizon in the Chernozemic soils. The Ck horizon is a dark grayish brown. Along the north wall of Excavation Unit 122, where the flow layer is thinnest, the parent material has been entirely incorporated into the developing Ah horizon and hence no Ck is apparent.

As seen elsewhere in soils where the only impact of the pedogenic state factors is the formation of organic-enriched Ah horizons, the soils are typically short-lived. Although the Ah horizon is slightly better developed here than in Orthic Regosols and some indication of structure development is apparent, neither Ah horizon is well expressed, thus indicating a soil which has had only a short period of time in which to form before its subsequent burial under modern erosional products. A time period of a few hundred years is probably sufficient to account for such development. Because it is known that the overburden is of very recent age, it is probable that the soil had been forming over a period of, perhaps, 150 - 200 years prior to park development.

A Rego Black Chernozem has formed in the paleosurface underlying the small flow layer. Characterized by a thick, black Ah horizon, a dark olive gray Ck horizon and a zone of secondary carbonate enrichment, the Cca horizon, it is indicative of a soil which has had sufficient time to develop features other than a simple Ah horizon. The appearance of a slow-forming Cca horizon suggests comparatively longer periods of time for soil formation and, hence, pre-existing land surface stability. Although, in relative terms, soil structure is better expressed than in the succeeding paleosol, the blocky, columnar structure of the A horizon is less developed than in the neighbouring Chernozemic soils which have not been buried by the subsequent flow surface. Given, however, the general equivalence of the Chernozemic soils in both the western and eastern portions of the excavation units, the two soils probably developed in the same paleosurface. Development of the Chernozem ceased in the latter area when it was isolated from the surface, that is, buried below the zone of biological activity.

As has been previously seen, Cca horizon formation may sometimes be measured in terms of thousands rather than hundreds of years and hence the paleosurface in which the Chernozemic soils have formed must have been stable over a comparatively long period of time. Although secondary carbonate accumulations were not seen in the Chernozemic soils of the western units, it is probable that they do occur, but below the excavated depth of the unit.

In summary, sedimentological analysis, sedimentary structures and soil development yield the following information:

1. The Chernozemic soils in both the western and eastern portions of the block excavation have developed in a single, continuous paleosurface. Formed in a large flow surface, signifying a major flow event, the soils have formed over a relatively long time frame, i.e., one which may be measured in terms of thousands rather than hundreds of years. In turn, the long period of soil formation indicates that the former surface had been unaffected by disruptive erosional processes during the life of its formation and, therefore,

had provided a comparatively stable surface. If this interpretation is accurate and a long time frame is indicated, then the flow surface was probably stabilized prior to Blackduck times, providing a groundscape on which cultural materials could have been deposited. In other words, artifacts found on this buried surface or in their contained soils are more likely to be in situ than in more recent flow surfaces. During or after Blackduck times, earth or solifluction-like flows could have carried and redistributed previously in situ artifacts onto subsequently stabilized surfaces, which then incorporated within themselves the transported cultural remains.

2. A relatively small flow surface of recent age has overridden the paleosurface in the eastern portion of the block excavation. Age assessment based on the degree of development of soil features suggests that it is unlikely to have developed over much more than a few hundred years. Given that the overburden is known to be of very recent age, the flow probably occurred and was stabilized within the past 150-200 years. It also indicates that fluidized mass movements have occurred in the recent past, although the magnitude and frequency of such flows has likely diminished since Blackduck times.

3. The overburden is a natural product of runoff water and wind sorting of adjacent road bed materials. It is no older than the age of the park itself.

Figures 34 and 35 give the depositional units and their contained soils; Figures 36 and 37 show the Chernozem profile in the western units and the buried paleosols in the eastern units.

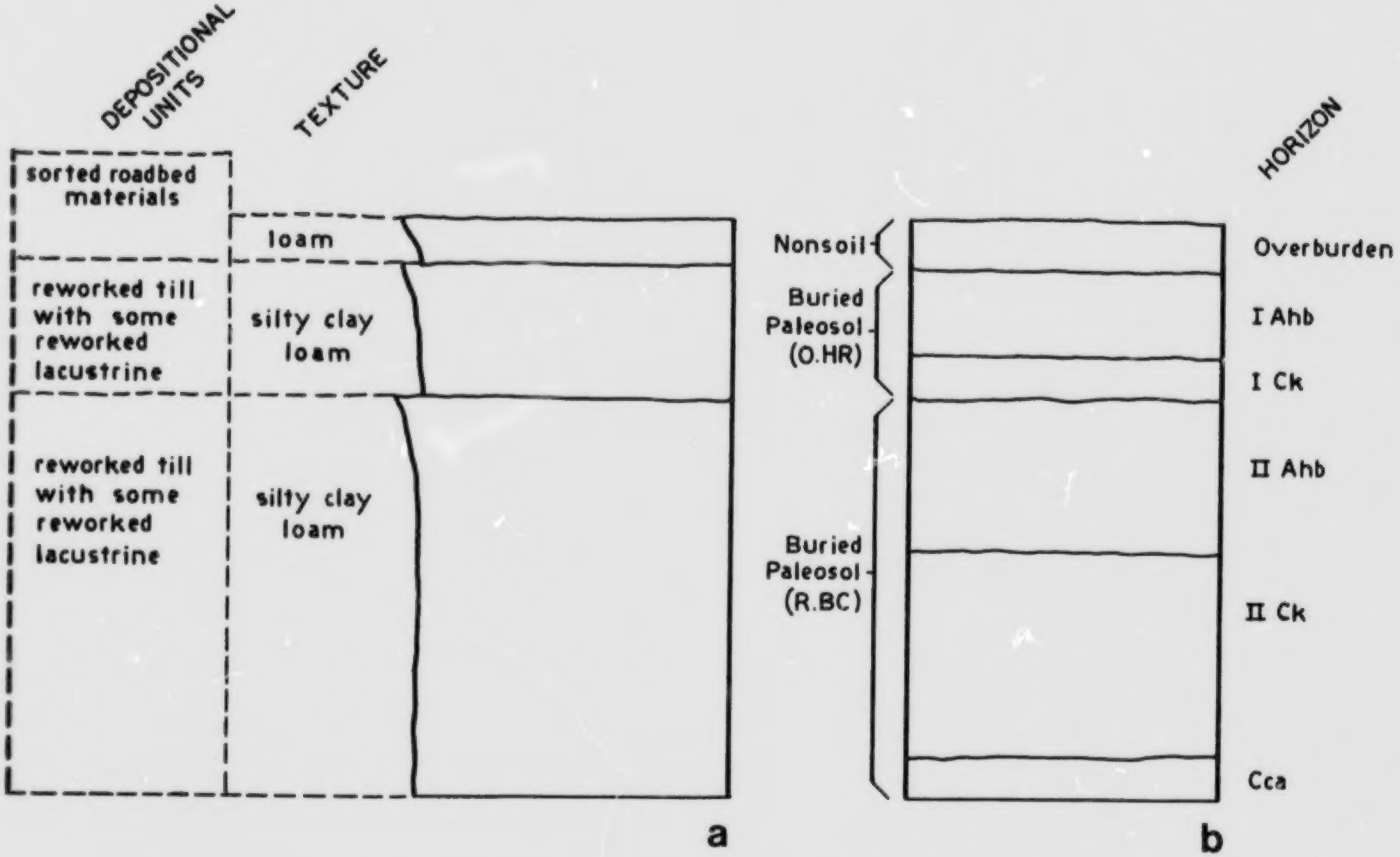

DEPOSITIONAL UNITS
TEXTURE
HORIZON
sorted roadbed materials
reworked till with some reworked lacustrine
reworked till with some reworked lacustrine
loam
silty clay loam
silty clay loam
a
Nonsoil
Buried Paleosol (O.HR)
Buried Paleosol (R.BC)
Overburden
I Ahb
I Ck
II Ahb
II Ck
Cca
b

Figure 34. Depositional units, texture and soil horizons occurring in Unit 121. (a) gives the depositional sequence and (b) gives the horizon pattern for the shallowly buried Rego Black Chernozem. Unit 121 is representative of the deposits and soil formation occurring in the four westernmost units.

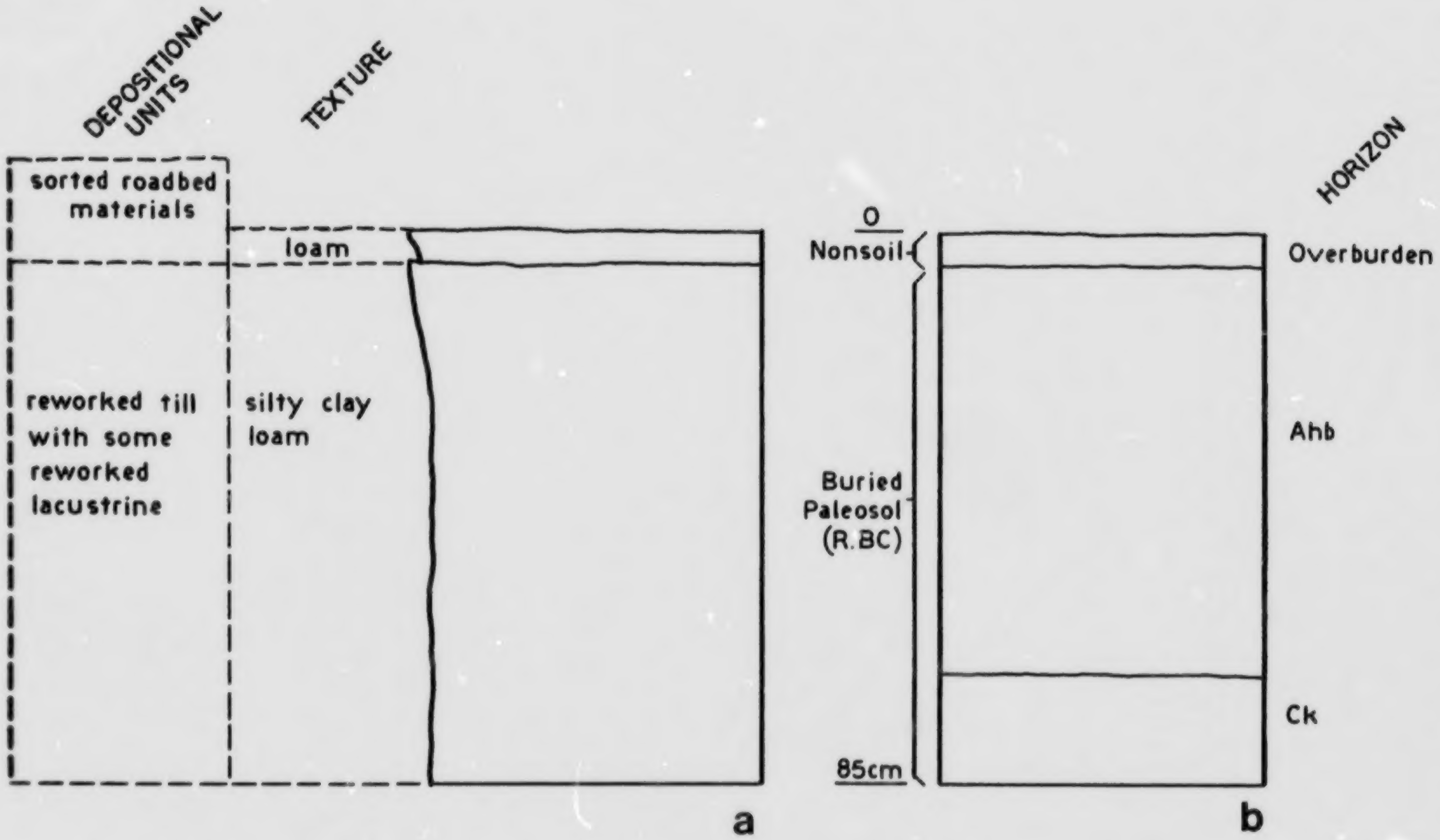

DEPOSITIONAL UNITS
TEXTURE
HORIZON
sorted roadbed materials
reworked till with some reworked lacustrine
loam
silty clay loam
a
0
Nonsoil
Buried Paleosol (R.BC)
85cm
Overburden
Ahb
Ck
b

Figure 35. Depositional units, texture and soil horizons occurring in Unit 119. (a) gives the depositional sequence and (b) gives the horizon pattern for the buried Rego Black Chernozem (lower paleosol). The north wall of Unit 122 has a similar depositional and soil formation sequence.

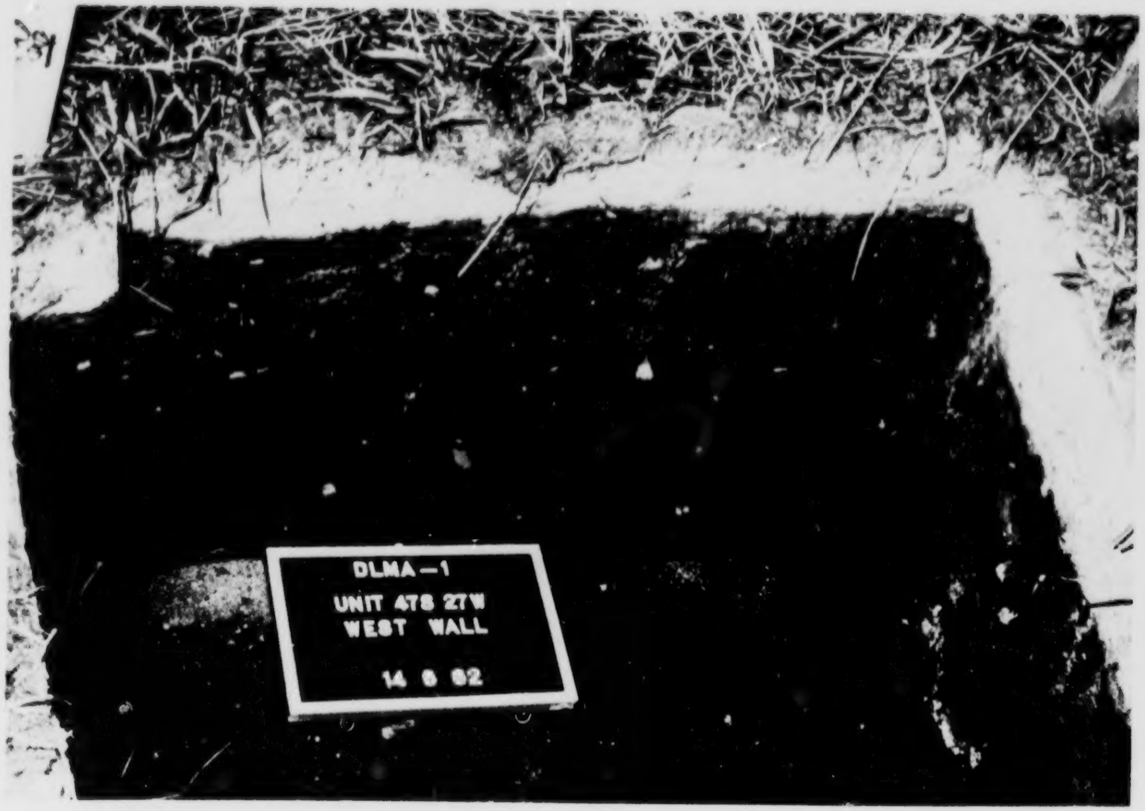

DLMA—1
UNIT 47S 27W
WEST WALL
14 6 82

Figure 36. Chernozemic profile. A Rego Black Chernozem profile shallowly buried by a light-coloured overburden.

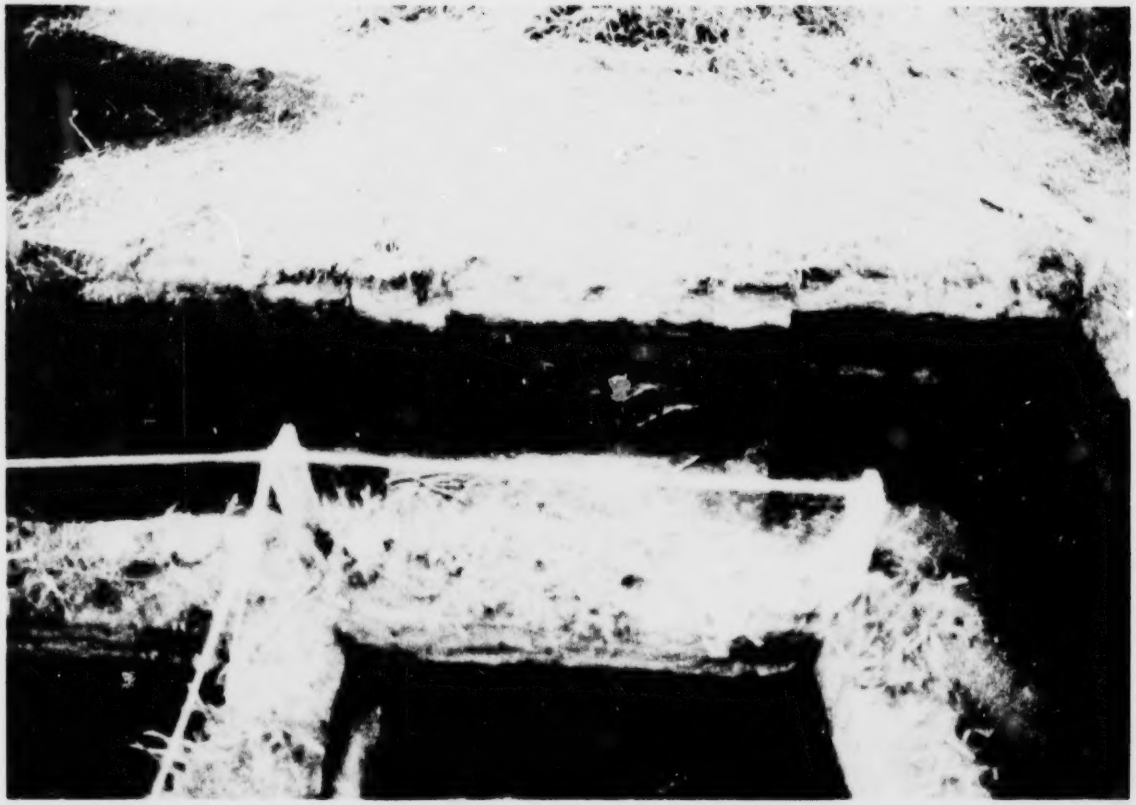


Figure 37. Sequence of buried paleosols. This sequence occurs in the eastern portion of the block excavation in units 46S 25W and 47S 25W. The bottom paleosol is a Rego Black Chernozem and has probably developed in the same surface as the chernozems in the western units of the block.

CHAPTER III

FAUNAL RECOVERIES

All faunal material from the 1982 excavations at the Stott Site near Brandon, Manitoba, was analyzed during a period of four months in the fall of 1982. This analysis includes bone from Units 99 - 104 and 125 in Area F on the west side of the highway, referred to as the "farm side", and Units 105 - 124 in Area Upper B on the east side of the highway in Grand Valley Provincial Recreation Park (see Figure 2). Roughly 27 m^3 of soil were excavated, containing an estimated 66,643 pieces of bone weighing 87,758.9 g (87.76 kg).

Bone from Area F on the farm side, excavated from 7.5 m^3 of soil, totalled 53,983 pieces weighing 63,129.6 g (Tables 1 and 2); its density was 7,198 pieces weighing 8,417 g per m^3. Bone from Area Upper B, excavated from 19.5 m^3 of soil, totalled 12,661 pieces weighing 24,629.3 g (Tables 1 and 2); its density was 649 pieces weighing 1,263 g per m^3. Density of bone on the farm side, therefore, was 11 times greater by count and more than six times greater by weight than on the park side. There were also more cut and butchered bones on the farm side (Table 3), with 307 cut-marked bones from the 7.5 m^3 of soil averaging 41 cut-marked bones per m^3. On the park side, 46 cut-marked bones from 19.5 m^3 of soil averaged 2.4 cut-marked bones per m^3.

Bison (Bison bison) is by far the most common species representing 41% of the total by weight (Table 4). Close to 21% of bones by weight are identifiable to cloven hoofed mammals (large Artiodactyla), bison or cow (large Bovid) and large mammal. These pieces are all likely bison, although more specific identification was impossible due to fragmentation or erosion. The rest of the identifiable species totalled less than 1% by weight. These animals were the canids or dogs, followed by beaver (Castor canadensis), rabbits or hares (Leporidae), deer (Cervids), black bear (Ursus americanus),

TABLE 1

TOTAL FAUNA BY NUMBER OF PIECES PER UNIT

	AREA F			AREA UPPER B			
	Units 99-101	Units 102-104	Unit 125	Units 105-110	Units 111-116	Units 117-118	Units 119-124
Bison bison	394	25	63	10	90	71	34
Large Artiodactyla	259	18	38	4	23	28	23
Large Bovid	3				1		
Large Mammal	670	38	174	9	73	81	35
Cervid	4						
Artiodactyla	2				2		
Medium-Large Mammal	42345	1120	8466	145	4839	3953	3144
Carnivora	8			1		6	1
Canidae	20	1	8	4	4	4	
Ursus americanus	1						
Taxidea taxus	1						
Mephitis mephitis			1				
Felidae	1						
Lynx sp.	1						
Leporidae	12		3				
Spermophilus franklinii					1		
Spermophilus sp.			14		2		1
Thomomys talpoides			1		1		3
Castor canadensis	17		4		1	1	
Small Rodent	5		8				
Small-Medium Mammal	21		11		2	4	1
Aves	6		1		3		
Accipitridae		1					
Haliaeetus leucocephalus	1						
Osteichthyes	5		1				4
Mollusca	55			1	12	1	
Lampsilis sp.					2		
Reptile - Turtle	3						
Reptile - Snake	1						
Class Uncertain	105		47	2	23	6	5
Unit Totals	43940	1203	8840	176	5079	4155	3251

TABLE 2

TOTAL FAUNA BY GRAMS PER UNIT

	AREA F			AREA UPPER B			
	Units 99-101	Units 102-104	Unit 125	Units 105-110	Units 111-116	Units 117-118	Units 119-124
Bison bison	19421.6	1017.5	2758.6	315.6	6034.8	4574.5	1878.9
Large Artiodactyla	3893.7	189.4	503.3	52.7	523.0	508.8	551.4
Large Bovid	126.1				4.4		
Large Mammal	7142.6	358.7	1683.5	118.6	962.9	1130.7	571.7
Cervid	7.2						
Artiodactyla	0.8				4.5		
Medium-Large Mammal	21019.1	727.1	3891.1	161.8	2877.6	2378.9	1831.8
Carnivora	7.4			1.6		2.7	4.0
Canidae	90.1	22.7	29.7	27.3	10.5	28.5	
Ursus americanus	92.4						
Taxidea taxus	2.0						
Mephitus mephitis			0.5				
Felidae	0.1						
Lynx sp.	3.2						
Leporidae	4.5		1.2				
Spermophilus franklinii					1.7		
Spermophilus sp.			2.4		0.3		0.1
Thomomys talpoides			0.2		1.1		1.0
Castor canadensis	55.3		3.5		1.0	0.8	
Small Rodent	0.4		0.7				
Small-Medium Mammal	15.3		3.3		3.8	3.6	0.7
Aves	1.0		0.3		2.5		
Accipitridae		0.7					
Haliaeetus leucocephalus	1.3						
Osteichthyes	0.4		0.1				2.2
Mollusca	15.2			0.3	10.3	1.0	
Lampsilis sp.					33.9		
Reptile - Turtle	1.5						
Reptile - Snake	0.1						
Class Uncertain	18.9		14.9	0.8	4.9	1.8	0.3
Unit Totals by Grams	51920.2	2316.1	8893.3	678.7	10477.2	8631.3	4842.1

TABLE 3

BONES WITH CUT MARKS

Farm Side

			From Less Specifically Identifiable Medium-Large Mammals				
UNITS	LARGE ARTIODACTYL & BISON	OTHER MAMMALS	RIBS	VERTEBRAE	EXTREMITY SHAFTS	FRAGMENTS	TOTALS
99-101	59	1 bear 1 canid 1 beaver	53	8	33	97	253
102-104	4		3		4	2	13
125	11		6	1	10	13	41
Farm Side Totals	74	3	62	9	47	112	307

Park Side

			From Less Specifically Identifiable Medium Large Mammals				
UNITS	LARGE ARTIODACTYL & BISON	OTHER MAMMALS	RIBS	VERTEBRAE	EXTREMITY SHAFTS	FRAGMENTS	TOTALS
105-110			1		1		2
111-116	5		5		1	4	15
117-118	2		8		2	5	17
119-124	2		2		2	6	12
Park Side Totals	9	0	16	0	6	15	46

TABLE 4

STOTT SITE FAUNAL SUMMARY

	NUMBER OF PIECES	% PIECES	% WEIGHT	WEIGHT BY GRAMS
Bison bison	687	1.0	41.0	36,001.5
Large Artiodactyla	393	0.6	7.1	6,222.3
Large Bovid	4	<0.1	0.1	130.5
Large Mammal	1,080	1.6	13.6	11,968.7
Cervid	4	<0.1	<0.1	7.2
Artiodactyla	4	<0.1	<0.1	5.3
Medium-Large Mammal	64,012*	96.0	37.5	32,887.4
Carnivora	16	<0.1	<0.1	15.7
Canidae	41	<0.1	0.2	208.8
Ursus americanus	1	<0.1	0.1	92.4
Taxidea taxus	1	<0.1	<0.1	2.0
Mephitis mephitis	1	<0.1	<0.1	0.5
Felidae	1	<0.1	<0.1	0.1
Lynx sp.	1	<0.1	<0.1	3.2
Leporidae	15	<0.1	<0.1	5.7
Spermophilus franklinii	1	<0.1	<0.1	1.7
Spermophilus sp.	17	<0.1	<0.1	2.8
Thomomys talpoides	5	<0.1	<0.1	2.3
Castor canadensis	23	<0.1	<0.1	60.6
Small Rodent	13	<0.1	<0.1	1.1
Small-Medium Mammal	39	<0.1	<0.1	26.7
Aves	10	<0.1	<0.1	3.8
Accipitridae	1	<0.1	<0.1	0.7
Haliaeetus leucocephalus	1	<0.1	<0.1	1.3
Osteichthyes	10	<0.1	<0.1	2.7
Mollusca	69	0.1	<0.1	26.8
Lampsilis sp.	2	<0.1	<0.1	33.9
Reptile - Turtle	3	<0.1	<0.1	1.5
Reptile - Snake	1	<0.1	<0.1	0.1
Class Uncertain	188	0.3	<0.1	41.6
TOTALS	66,644*	99.6%	99.6%	87,758.9 gr.

* Estimate based on completely counting and weighing fragments less than 5 cm long from Unit 99 and applying a factor derived from them to other weighed fragments.

badger (Taxidea taxus), skunk (Mephitis mephitis) and lynx (Lynx sp.). The only bird specimen identified was a bald eagle (Haliaeetus leucocephalus). None of the fish bones were specifically identifiable. Two of the molluscs were recognizable as a common freshwater clam (Lampsilis sp.). The few reptiles could only be classified to turtle and snake. The Franklin's ground squirrel (Spermophilus franklinii) and the northern pocket gopher (Thomomys talpoides are likely intrusive in the archaeological assemblage and have no cultural significance. The remaining 37.5% of the weight was from medium-large mammal fragments. In general, the condition of the bone ranged from weathered to good. Much more bone was chewed by carnivores than by rodents and is therefore affected by some scavenging.

In order to quicken the processing of bone fragments, i.e. pieces with all dimensions less than 5 cm, an approximating technique was devised. The approximation was based on all medium-large mammal bone fragments from Unit 99, which were completely counted, weighed and separated into burned and unburned categories. The two groups were then weighed and an average weight per piece obtained. Consequently, an unburned fragment identifiable only as medium-large mammal weighed 0.47 g; a burned fragment weighed 0.43 g. Subsequently, all medium-large mammal bone fragments in the remaining units were weighed and the count approximated, using the burned or unburned average where appropriate. No bone fragment with any dimension greater than 5 cm was averaged; any bone from small animals was also treated separately.

Units 99 - 101 Units 99, 100 and 101 (Figure 8) contained a well-defined bone bed varying slightly in thickness from 20 - 25 cm and extending through the following levels:

Unit 99	Levels 3 - 7 (10 - 35 cm)	Concentration Level 6 (25 - 30 cm)
Unit 100	Levels 4 - 7 (15 - 35 cm)	Concentration Level 6 (25 - 30 cm)
Unit 101	Levels 5 - 8 (20 - 40 cm)	Concentration Level 6 (25 - 30 cm)

In each unit, the top of the bone bed was difficult to define precisely, because there were many small fragmented pieces of bone also found above the bone bed. Its termination, however, was delineated by a marked decrease in bone totals at 40 - 45 cm below the surface. In these three units, a localized and consistent concentration of bone appeared on Level 6 (25 - 30 cm).

All of the major bison elements, except lumbar vertebrae, as shown in Table 5, were present in these units. It is interesting to note that Unit 99 contained the only dorsal ends of ribs from this excavated assemblage. Many other ribs were found, but they were always mid-shaft sections. Right-sided bison elements were slightly more numerous than left-sided elements, with front elements more common than hind elements. However, even when the skeletal patterns were studied in more detail, no particular bone distribution could be discerned.

Units 99 - 101 contained a great concentration of bison bone, indicating that meat was cut from the bones at this locale and that bones were broken as part of the butchering process and for preparing grease as well. Although the bone bed was defined by the presence of bison, it is in the bone bed that the greatest variety of the less commonly identified animals, such as bear, badger, lynx and eagle, occur. Several bison elements and only a few other animals were found outside the bone bed, either above or below it. There were more dogs/coyotes, rabbits and beaver present in these units than anywhere else.

TABLE 5

DISTRIBUTION OF MAJOR BISON SKELETAL ELEMENTS

	FARM SIDE			PARK SIDE			
				UNITS			
BISON ELEMENTS	99-101	102-104	125	105-110	111-116	117-118	119-124
Cranial							
Skull	X*		X	X		X	X
Mandible	X		X		X	X	X
Axial							
Cervical	X		X		X	X	X
Thoracic	X		X			X	
Lumbar				X		X	
Sacral	X				X		
Ribs	X						
Front Leg							
Scapula	X	X			X	X	X
Humerus	X		X		X	X	X
Radius	X	X	X		X	X	
Ulna	X	X	X		X	X	X
Metacarpal	X	X		X	X	X	X
Hind Leg							
Innominate	X		X		X	X	
Femur	X		X		X		
Tibia	X	X	X		X		X
Metatarsal	X	X	X		X	X	X

X* indicates presence

Units 102 - 104 Units 102 - 104 (Figure 8) contained little scattered bone and no bone bed. There were, however, two features in Unit 102 consisting of vertical bison bone placed in V-shaped pits. These are discussed in the Features section of Chapter IV.

Unit 125 The bone material from Unit 125 (Figure 8) closely resembles that from Units 99 - 101. A well-defined bone bed 25 cm thick extended from Level 3 (20 cm) to its termination at the end of Level 7 (45 cm). As with Units 99 - 101, the beginning of the bone bed was difficult to distinguish, although its end was quite obvious. Curiously, within this bone bed a marked decrease of fragmented medium-large sized mammal bone occurred at Level 5 (30 - 35 cm). Also, there was less bison bone at Level 5 compared with the amounts in both Levels 4 and 6. This kind of variation did not occur in Units 99 - 101. Whether the decrease at Level 5 indicates the presence of two thin bone beds remains unclear at this time (see Features section of Chapter IV).

Nearly all of the major bison skeletal elements are represented in Unit 125 (Table 5). Two right front legs and one right hind leg were present, indicating that at this locale, the majority of the meat processing occurred to the right sides of bison. Cut marks were found on bones and all appeared to have been broken for bone grease. As in Units 99 - 101, the majority of animals other than bison were found in the bone bed. Bison, canids, rabbits and beaver were found in Levels 3 and 4 (20 - 30 cm) and in Levels 6 and 7 (35 - 45 cm). Bison and a single gopher bone were located in the possible separation level, Level 5 (30 - 35 cm).

Units 105 - 110 Units 105 - 110 (Figure 9) contained the least bone of any excavated area in 1982, with no apparent evidence of a bone bed. Two pieces of bone bore cut marks (Table 3) and a few bison elements were present (Table 5). The only other animal bone identified from this area was canid.

Units 111 - 116 Units 111 - 116 (Figure 9) contained a bone bed approximately 15 cm thick at 35 - 50 cm below the surface. In these units, the bed possessed a distinct beginning and end, with the greatest concentration of bone occurring 45 - 50 cm below the surface. Cut marks were found on 15 bone pieces (Table 3). Bison front and hind limbs of both sides were roughly equal in representation. No specifically identifiable animals other than bison occurred above the bone bed. The bed itself contained bison and one or two pieces each of beaver, canid and Lampsilis sp. Below the bone bed, there was one other Lampsilis sp. and two likely intrusive rodents, the Franklin's ground squirrel and the northern pocket gopher.

Units 117 - 118 Units 117 and 118 (Figure 9) contained a bone bed 15 cm thick at a depth of 30 - 45 cm beneath the ground surface. The beginning of this bed was distinguished by a marked increase in bone, with a concentration appearing 35 - 40 cm beneath the surface. However, the termination of the bed occurred more gradually than in any of the other units; between 50 - 55 cm, there were still a few large pieces of bison recovered. Cut marks were found on 17 bones (Table 3). Nearly all of the bison elements were well represented, with the majority of limb elements being from the right front leg. Most of the smaller animal bones were found in the bed and consisted of canid and beaver bone.

Units 119 - 124 Units 119 - 124 (Figure 9) did not contain as dense a bone bed. A 15 cm thick concentration occurred at 30 - 45 cm below the surface, but it was not as well marked as the beds in other units. Twelve bones bore cut marks (Table 3). Bison elements were present in most of the major skeletal groups (Table 5), but they were only sparsely distributed. The only animal other than bison that was specifically identifiable was the northern pocket gopher, found both above and within the bone bed.

Bison (*Bison bison*) The minimum number of bison was calculated treating Area F on the farm side separately from Area Upper B on the park side. Single elements were tallied from each area. Based on 10 right proximal metatarsals from the farm side and four right distal humeri from the park side, the minimum number of bison was estimated to be 14. As only the distal humeri of these two sets of elements can be used to estimate age, only four bison could be assessed an age of at least four years (Koch 1935:372). In order to estimate a more complete age range of the bison present, incomplete mandibles were used to age 12 of the 14 bison by utilizing the technique described by Fuller (1959:344), which is based on tooth eruption and wear (Table 6).

TABLE 6

AGES OF STOTT BISON

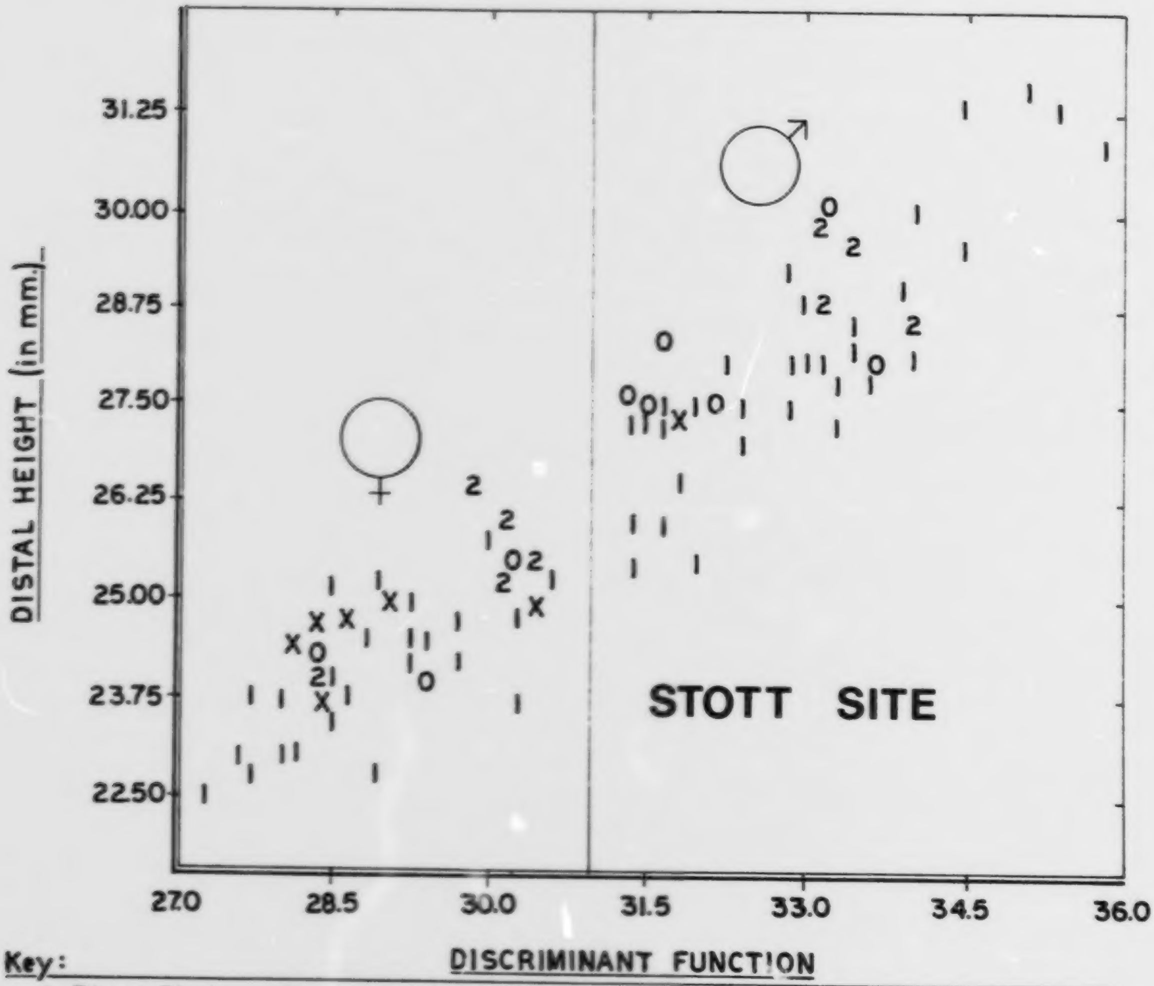
AGE CLASS	NUMBER AT DlMa-1
Calf (less than 1 year)	1
Yearling (1 - 2 years)	3
Spike Horn (2, 3 and some 4 years)	3
Young Adult (4 to 7 or 8 years)	3
Adult (6 - 12 years)	1
Aged (greater than 12 - 15 years)	1
TOTAL NUMBER OF BISON	12

Herd Composition All suitable proximal front phalanges from all excavations at the Stott Site (1947 - 1982) were analyzed to determine herd composition. These phalanges were sexed using the method described by Roberts (1982). Three measurements; length (L), greatest length (GL) and distal height (DH) were taken and the measurements included in the following equation:

(GL x 0.52067) + (DH x 0.54678) - (L x 0.29469) = discriminant function.

The function can be plotted against the distal height measurement. Those phalanges with a function greater than 31.14 are male and with a product less than 30.96 are female. Figure 38 illustrates the 43 phalanges assessed as female and the 47 phalanges considered male. By allocating four proximal phalanges per bison, there are approximately 11 females and 12 males at the site. If there were a heavy single deposition of bison bone representing the remains of one event, then this ratio could have been used to establish seasonality. However, previous radiocarbon dates have demonstrated that many occupations occurred at the site and erosional factors make it impossible to separate these occupations either vertically or horizontally. Therefore, this ratio can only be used in support of other evidence for seasonality of occupation at the site.

Butchering/Cut Marks There was a total of 83 cut marks on bone identifiable to Bison and/or Large Artiodactyl. As no domestic cow, moose or elk were identified from the assemblage, it is assumed for the purpose of this discussion that these bones are from bison. The kinds of cut marks found on the bison cranial and axial skeleton are schematically illustrated in Figure 39. Cut marks to the skull are found around the eye orbit and premaxilla, likely resulting from skinning around the eye and nose. Cuts to the mandible



Key:

1 - Bison Phalanx Excavated 1945-1980
2 - Two Bison Phalanges Excavated (occupying same location on graph) 1945-1980
X - Bison Phalanx Excavated 1981
O - Bison Phalanx Excavated 1982

Figure 38. Distribution of male and female Bison phalanges.

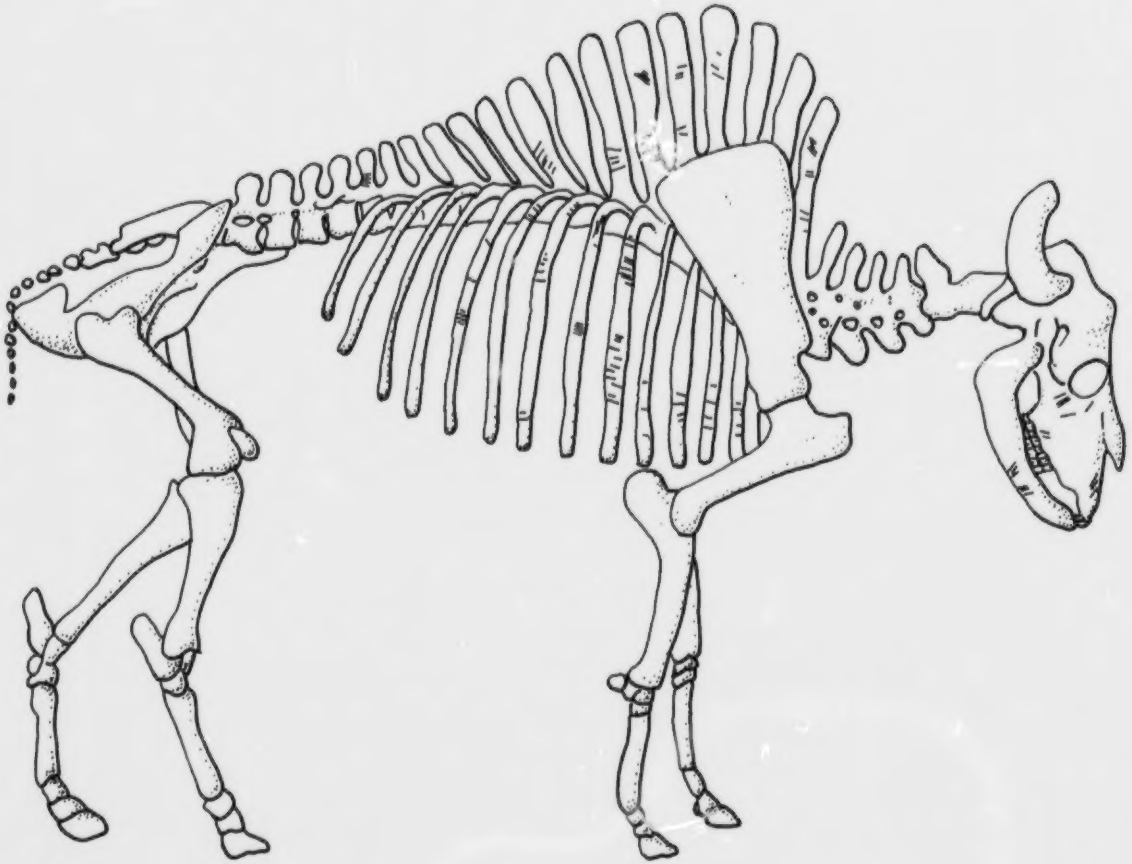


Figure 39. Lateral cutmarks to the Bison crania, mandible, ribs and vertebrae. Adapted from Neuman 1975: 100.

along the ventral and lateral borders probably also result from the skinning process. Cuts on the medial surface of the mandible are likely related to removal of the tongue.

The cervical, thoracic and lumbar spines have cut marks as shown, although the exact order and placement of the marks from C7 through to L2 in Figure 39 are arbitrary. The lateral cuts transverse to the long axis of the ribs are also arbitrarily placed, as rib fragments could not be located exactly. The medial cuts often consisted of curved, long sweeping marks parallel with the length of the rib. The anterior and posterior edges of the ribs often evidence a series of short hatching strokes. No cuts were found on the innominates.

Figure 40 illustrates cuts to the front leg of the bison, including the scapula, humerus, radius, ulna, carpi ulnare, metacarpal and proximal phalanges. A left leg is illustrated, with all cuts superimposed onto the one leg. The kind of hatching used in Figure 40 is indicative of the kind of cuts actually found on the bones. No cut is illustrated twice.

The most distally cut-marked bones are two proximal phalanges. The cuts were placed anteriorly and would have severed the tendons. It is doubtful that these marks result from skinning, as the tendons are so tough and fibrous they would need to be purposefully cut through to mark the bone. At the metacarpal, there were five superficial cut marks anteriorly and one cut medially. There was one cut across the lateral surface of the carpi ulnare. One cut was placed at the distal articular surface of the radius, apparently a result of severing the foot from the leg at the "wrist". The majority of the cuts are located around the elbow joint near the tendenous and ligamentous attachments for either the origin or insertions of muscles. At

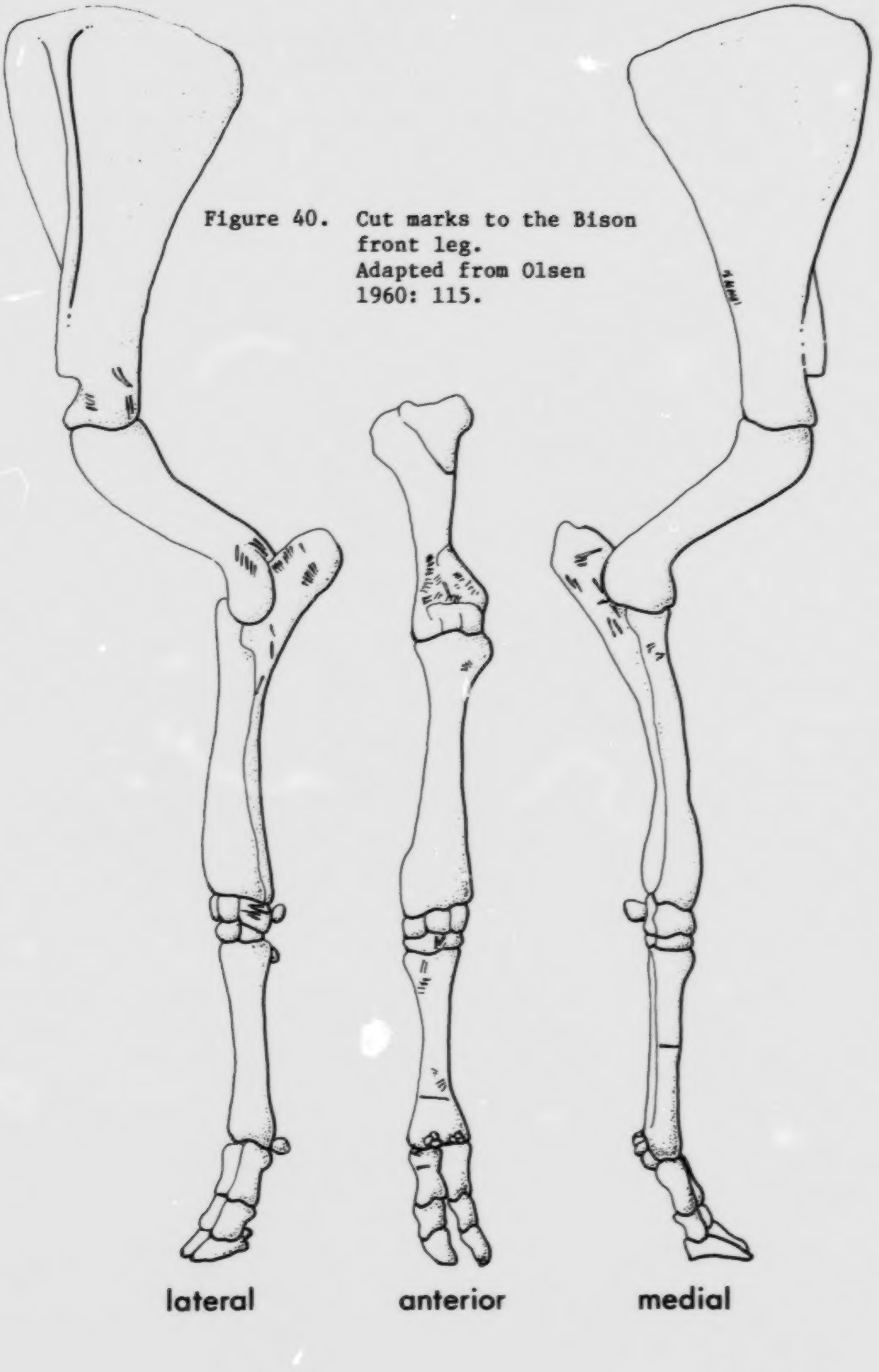

lateral
anterior
medial

Figure 40. Cut marks to the Bison front leg. Adapted from Olsen 1960: 115.

the shoulder, there were three cuts at the head and neck of the scapula to reach the bodies of the supraspinatous and infraspinatous muscles of the scapula. The one cut to the posterior border of the scapula was probably designed to sever the intermuscular septa attached there.

Figure 41 illustrates cuts to the hind leg of the bison, which includes the metatarsal, tibia and femur. There were no cuts to the hind phalanges, tarsals or the patella. Cuts to the metatarsal include two distal lateral, one anterior mid-shaft and four medial mid-shaft cuts. The tibia was cut twice anteriorly at the tibial crest and twice at the distal mid-shaft. There were three posterior and one lateral mid-shaft cuts to the tibia. Cuts to the femur include one cut to the posterior mid-shaft for the origin of the gastrocnemius and one at the medial mid-shaft. Four other femoral cuts were located proximally: one laterally, one inferiorly from the head at the neck, and two near the lesser trochanter and the eminence for the attachment of the gluteus profundus.

Summary of Butchering/Cut Marks

A total of 83 cut-marked bones identifiable to bison and large artiodactyla were recovered. Placement of the cuts generally follows the pattern described by Hamilton (1981:110-119). Exceptions to Hamilton's pattern include an absence of cuts to the innominates, the main body of the scapula and the tarsals, and an inclusion in the 1982 material of cuts to the proximal femur, phalanges and one carpal.

Of the 83 cut bones, nine came from the skull or mandible and apparently resulted from skinning the head and/or removing the tongue. Evidence from the 23 cut ribs and vertebrae indicates that meat was removed

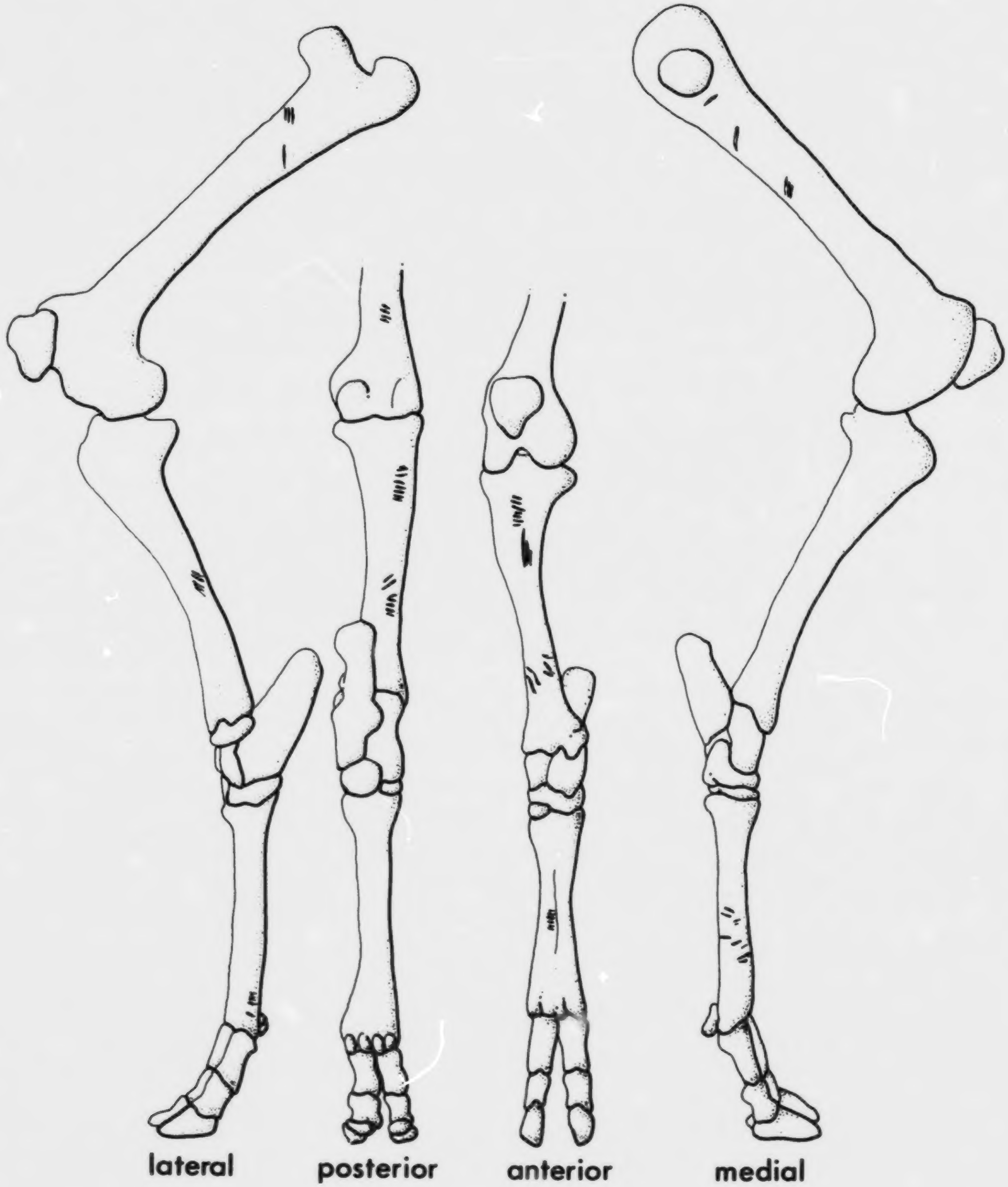

lateral
posterior
anterior
medial

Figure 41. Cut marks to the Bison hind leg. Adapted from Olsen 1960: 117.

from each side of the dorsal spines and also around the ribs. It is difficult to reconstruct the cutting process around the front (29 cuts) and the hind (22 cuts) legs. Cuts to the metapodials may have been from "the initial cut in the skinning-out process" (Hamilton 1981:114) and "encircling cuts made to initiate skinning activities" (Hamilton 1981:116). It is also possible that cuts to the metapodials were necessary to sever the protective periosteum encasing the bones in order to apply blows which would break the bones apart for ease in grease preparation. Only two metacarpals were found whole and neither bear any cut marks. This may suggest that they were not prepared for breaking apart. As for the rest of the front leg, it appears that muscles were stripped off the leg and detached at the elbow and shoulder joint. It is assumed that these cuts were made before the bones were broken. The hind leg muscles were apparently stripped from above the tarsal joint at the distal end of the tibia. There were no cuts to the patellae, but as they were often carnivore-chewed, much of the original bone surface was obliterated. The muscles were stripped from the femur leaving most of the cut marks toward the proximal end.

Despite the butchering pattern just described, it is important to note that many bones had no cut marks, even those elements from the intensively processed portions such as the distal humerus, proximal ulna, and the metapodials. Much of the identifiable bone was processed without leaving any traces. Also, many other pieces of bone had cut marks (Table 3), but because of breakage, were not specifically identifiable and therefore not included in this description.

Bone Processing

After bones were at least partially stripped of their meat, they were broken to facilitate retrieving bone grease or in order to detach limbs or parts of the carcass.

Crania Only small fragments of the skull were found, except for one nearly complete left maxilla. In other instances, fragments of the premaxilla, maxilla, malar, palatine, temporal condyle, paramastoid, petrous tympanic, horn core and loose teeth were identified. There were no whole mandibles found. The largest piece recovered was a complete half, extending posteriorly from M_1. Mandibles were highly fragmented with pieces of the tooth row often broken ventrally at the mandibular foramen. Often breaks occurred leaving the diastema in a single piece; sometimes the coronoid process and the mandibular condyle also formed a single unit.

Vertebrae The most common vertebrae present were the cervicals. One nearly complete axis was recovered, with only the posterior and ventral portions of the body broken off; as well, two incomplete atlases were found. Four mid-cervicals were present, each with its lateral and ventral branches of the transverse processes broken. One C7 was nearly whole, except for a break at the tip of its dorsal spine. Another C7 was broken at each transverse process and also at the base of its spine.

The thoracic vertebrae were represented by five spines and one body with its dorsal spine removed. The lumbar vertebrae were represented by bodies, each having its transverse and dorsal spinous processes broken. The sacrum was represented by two first sacral segments, each broken at the arch. A single incomplete caudal vertebral body was also recovered.

Other fragments of vertebrae and their epiphyses were also noticed throughout the site, but were few and identifiable only to medium or large mammal. The lack of vertebrae signifies that either a) the kill and primary butchering sites were located elsewhere and the excavation units were placed in a camp and/or secondary butchering zone, or b) because of differential survival rates through weathering and/or carnivore chewing, these elements only occasionally remain.

Ribs The only ribs identifiable to bison were articular heads, four of which were found in 1982. In each instance, they were broken just below and within an inch of the tubercle. Many other ribs were present that were also likely bison, but as they were mid-shaft sections, could be identified to only Artiodactyla or large mammal.

Front Leg There were 14 scapulae present, two of which were complete. Six scapulae were broken across the spine, leaving the lateral one-third intact; four were broken at the neck, leaving the glenoid; one was broken so that the anterior portion of the glenoid and the spine remained; and one other specimen was broken at the neck, leaving one-third of the spine. Mid-body portions of scapulae were also found, but these could not be specifically identified.

The humeri were represented by 12 distal ends and four mid-shafts; no proximal ends were present. In reference to a similar absence of proximal ends of humeri in 1979, Hamilton considered that "the amounts of grease recovered from these bones was great enough to result in their being smashed to small pieces so that they were not recognized" (1981:123). However, there is another plausible explanation for differential recovery of proximal and distal ends of humeri. The amount of carnivore-chewed bone recovered in 1982 could lead one to attribute the disappearance of thin-walled, highly cancellous ends of bones like the proximal humerus, proximal tibia and distal femur to the activities of camp dogs.

Ulnae were easily identified; five proximal ends, two distal ends and 24 mid-shaft pieces, often broken at the semi-lunar notch, were recovered.

The radii were represented by 11 proximal ends, two distal ends and six mid-shafts. In only two instances was the ulna found articulating with the radius.

The carpals were numerous (63 items) and nearly always found whole. The metacarpals were represented by 14 proximal ends and eight distal ends. Two metacarpals were found whole in Unit 112 in Area Upper B.

Hind Leg Among the innominates there were three complete acetabula, one of which included much of the ischium. Also, two partial acetabula with portions of the ischium attached were present. As well, there were two other portions recovered, one ilium specimen and one pubis. From the incomplete bones it appears that in order to remove the hind leg, it was easier to smash the innominate than cut the tough ligamentous attachments.

Femora were represented by two proximal heads, four large mid-shaft pieces and two distal ends.

Tibiae were more numerous than femora, perhaps because their mid-shaft fragments were more easily recognized, or maybe because the cortex of their distal ends is comparatively thicker. There were 13 distal ends, two distal fragments, nine mid-shaft pieces and no proximal ends.

The calcaneus (20 items), talus (8 items) and the tarsals (48 items) were abundant and nearly always found whole. Occasionally the calcaneus had been cleaved at the anterior and lateral projection, which articulates with the talus as well as the fused central and fourth tarsal.

Metatarsals were represented by 21 proximal ends and eight distal ends. None were found whole. The phalanges were plentiful and nearly always found whole, though often damaged. Proximal and middle phalanges were equally represented (47 each); the distal phalanges were less frequent with 23 specimens.

Summary All but two of the bison extremity shafts recovered in 1982 were broken. The only other bones found whole were two scapulae, the carpals, the tarsals and the phalanges. Of the bones that were broken but not completely smashed, it is likely that marrow was removed from their central cavities. The remaining shafts could have been used as "instant" tools, as uprights in the vertical bone features in Unit 102, or merely discarded. It seems likely that nearly all of the faunal material in the medium-large mammal category (Table 4) is fragmented bison bone. By estimated count, these 64,012 pieces would amount to 96% of the total faunal recoveries. By weight, this would total 32,887.4 g or 37% of the total weight recovered. All of these pieces had been reduced to fragments less than 5 cm long. It is obvious that bison bone was being completely utilized at DlMa-1, with the smaller fragments likely being boiled to make bone grease.

Proportional or Differential Recovery

The MNI for bison has been calculated at 14 individuals. In order to determine the proportion of skeletal elements remaining at the site, the number of skeletal elements was calculated as if all bones from the 14 bison were present. These figures appear in the first column of Table 7. The second column shows the actual number of elements present that were identifiable to bison (omitting loose teeth and all skull fragments except the premaxilla). The third column shows the percentage of the actual number in comparison with the expected number of elements (Figure 42).

The most common bones present at the site are the distal tibia, tarsals and the proximal metatarsal. The least commonly found elements are the proximal humerus, skull, distal ulna, proximal tibia, proximal femur, distal femur, horn core, thoracic, lumbar and caudal vertebrae and the ribs. The pattern of bison recovery at the Stott Site is similar to, but not exactly the same as that of the Stelzer Site in South Dakota, a Sonota camp with associated burial mounds and pits containing vertically placed bison bone (Neuman 1975). There the highest recovery was of the scapula, distal humerus, proximal radius, distal tibia and all the phalanges. The two patterns are comparable with the most frequent bones from the Stelzer Site also being recognized at the Stott Site, but with a recovery rate 21% higher than at the Stott Site. There is also agreement in the least frequently represented items, except that at the Stelzer Site there are proportionately more proximal femora (25%) than at the Stott Site (7%).

As stated earlier, proportional recovery figures can be explained if some bones were smashed beyond recognition, or if the bison were processed initially at the kill site, leaving behind certain elements. Also, it is likely that the kind of carnivore activity described by Brain (1976:108) could very well affect the differential recovery of certain skeletal parts. The graph in Figure 43, which is drawn from Table 8, includes data from four

TABLE 7

PROPORTIONAL RECOVERY OF BISON ELEMENTS

MAIN ELEMENTS	MNI OF ORIGINAL BONES BASED ON 14 BISON	ACTUAL NUMBER OF BONES	PERCENTAGE RECOVERED
Metatarsal, Proximal	28	22	79
Calcaneus	28	20	71
Tarsals (3 Major)	84	48	57
Tibia, Distal	28	16	54
Scapula	28	14	50
Metacarpal, Proximal	28	14	50
Humerus, Distal	28	12	43
Mandibles	28	12	43
Phalanges, Proximal	112	47	42
Phalanges, Middle	112	47	42
Radius, Proximal	28	11	39
Carpals	168	63	38
Patella	28	9	32
Metacarpal, Distal	28	8	29
Talus	28	8	29
Metatarsal, Distal	28	7	25
Phalanges, Distal	112	23	21
Skull, Premaxilla	28	5	18
Ulna, Proximal	28	5	18
Sacrum	14	2	14
Pelvis, Acetabulum	28	4	14
Radius, Distal	28	4	14
Vertebrae, Cervical (7)	98	11	12
Femur, Distal	28	2	7
Ulna, Distal	28	2	7
Horn Core	28	2	7
Vertebrae, Thoracic (13)	182	6	3
Vertebrae, Lumbar (6)	84	2	2
Ribs (24)	336	5	1
Vertebrae, Caudal (17)	238	1	0
Humerus, Proximal	28	0	0
Tibia, Proximal	28	0	0

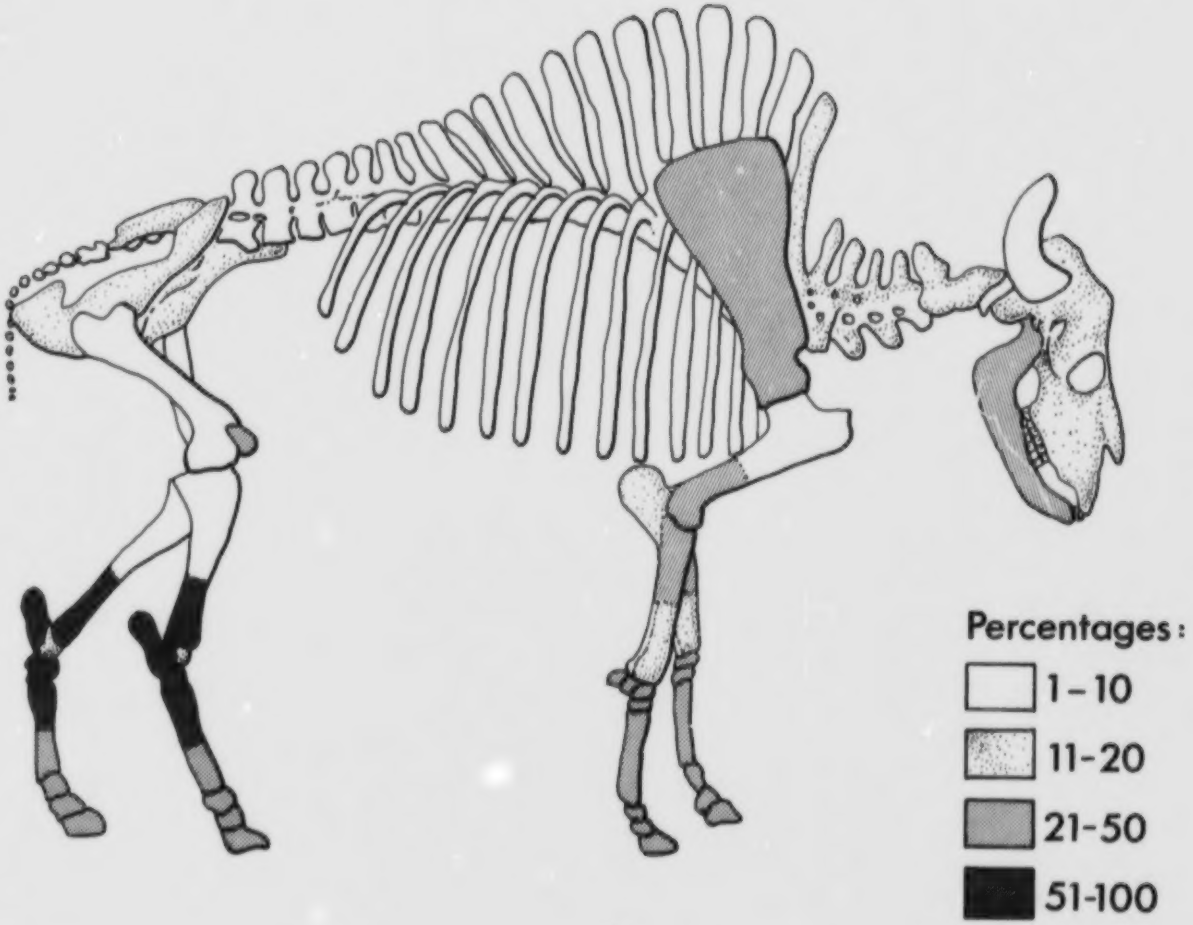

Percentages:
1–10
11–20
21–50
51–100

Figure 42. Proportional recovery of Bison elements. Adapted from Neuman 1975: 100.

sources based on the family Bovidae. There are bison data from the Stelzer Site (Neuman 1975:101); bison data from the Stott Site 1982 excavations; goat data from the Kuiseb River, East Africa (Brain 1976:109, 110); and antelope-like data from Makapansgat Limeworks, Africa, presented by Dart in 1957 and utilized by Brain (1976:112). The results are not identical, but they do follow the same trend of few proximal humeri, proximal femora, distal femora and proximal tibiae. There are plenty of distal humeri, proximal radii and ulnae, as well as distal tibiae. The distal radius and ulna are always present between the outer extremes. The data in Figure 43 are not presented as an attempt to disprove either the bone smashing or initial butchering site explanations for differential bone recovery at the Stott Site. However, in a site where canids are found within the faunal assemblage and much of the bone has been chewed, this pattern of skeletal recovery should be expected and recognized as contributing to the differential recovery.

TABLE 8

COMPARISON OF FAUNAL RECOVERY RATES

ELEMENT	% STOTT SITE	% STELZER SITE	% KUISEB	% MAKAPANSGAT
Humerus				
Proximal	0	12	0	6
Distal	43	88	64	57
Radius/Ulna				
Proximal	39	51	51	48
Distal	14	40	17	20
Femur				
Proximal	7	26	14	5
Distal	7	12	7	10
Tibia				
Proximal	0	16	10	11
Distal	54	95	56	20

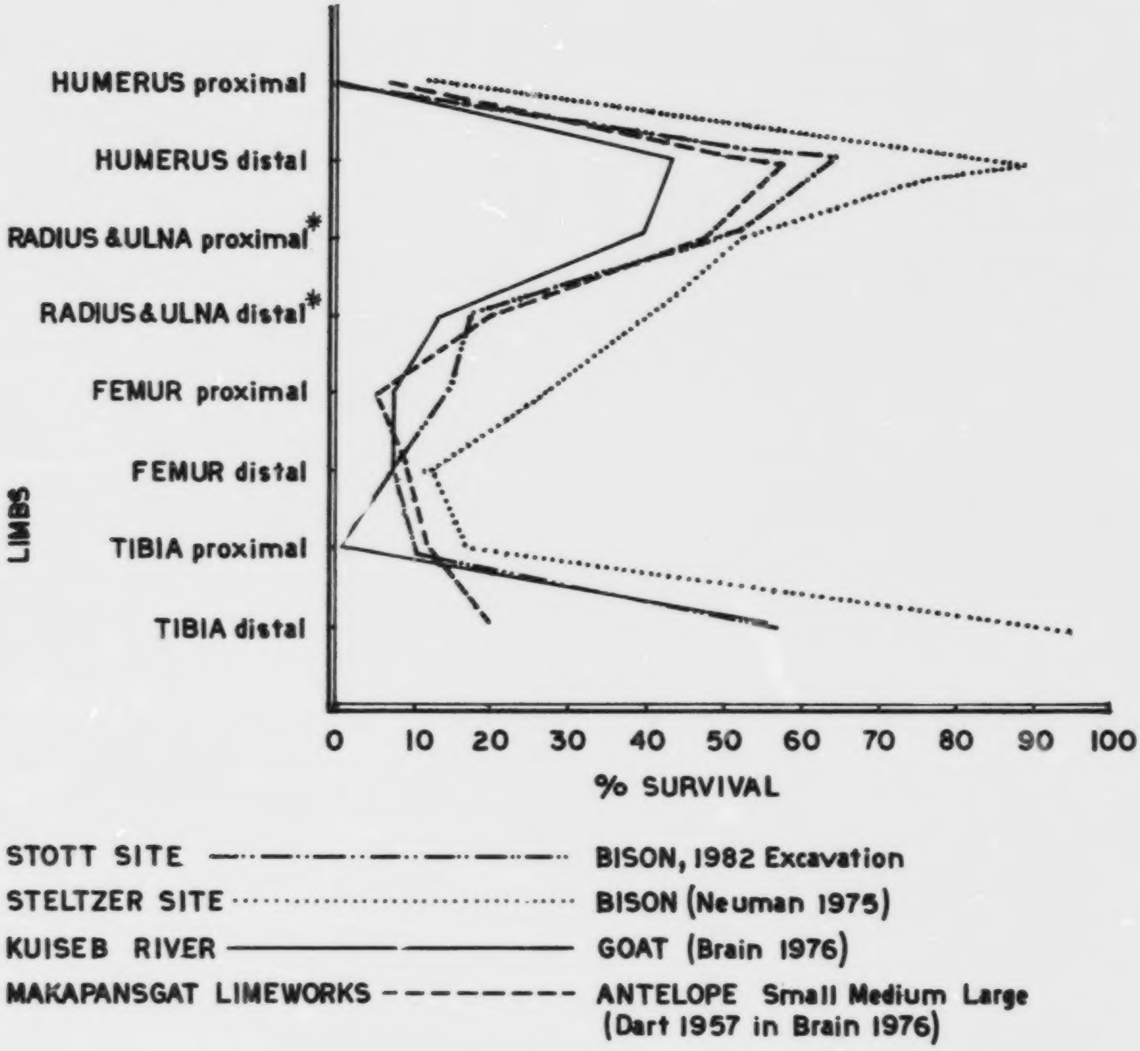


Figure 43. Comparison of proportional recovery rates.

* Owing to differences in calculations between authors, these two element sets are calculated only on the proximal radius and distal radius for both the Stott Site and the Steltzer Site.

Canidae Canids are represented by four categories, from the size of a red fox (Vulpes vulpes) up to that of a wolf (Canis lupus). Table 9 summarizes the numbers of bone per size category and the minimum number of individuals. The MNI was calculated using the same criteria as for bison, with all the elements from Area F, the farm side, considered separately from the elements in Area Upper B, the park side. There were at least eight canids at the site.

The kinds of bones found include some skull fragments, mandibles, loose teeth, one humerus, several ulnae, metacarpals, femora, tibiae, metatarsals and phalanges. There are two nearly complete mandibles, each fitting between the coyote (Canis latrans) and wolf (Canis lupus) in size range. One of the mandibles is made up of several pieces -- 101-321, 101-272 and 100-311/4. It shows evidence of being skinned, as there are fine cut marks along its ventral border. This mandible also contains a P_1, commonly found in wild canid specimens. The second mandible, 103-7, has no cut marks. It has a shortened tooth row and there is no alveolus for a P_1 as is usually found in domestic dogs. As no whole or nearly whole skulls were recovered, there is little substantive evidence for domestic dogs. However, as Hamilton noted (1981:198), the possibility of domestication should be considered for this intermediate size group of canids.

TABLE 9

SIZE CATEGORIES AND MNI OF CANIDS

CANIDS	NUMBER OF PIECES	MNI
Size of red fox (Vulpes vulpes)	5	3
Size of coyote (Canis latrans)	3	1
Size between Canis latrans and Canis lupus	22	2
Size of wolf (Canis lupus)	5	2
TOTAL	35*	8

*This total is less than in Table 10 because some specimens could be fitted together.

Beaver The beaver was represented by two individuals. None of the skeletal parts were duplicated and the MNI was based on the farm/park separation. Skeletal parts recovered include skull fragments, mandibles, tooth fragments, vertebrae, a femur and both front and rear foot bones.

Cut marks were found on one mandible, possibly from disarticulating the jaw from the skull.

Rabbits and Hares Rabbits and hares (Leporidae) were represented by three individuals, all recovered in Area F. There are duplicate portions of two right mandibles and one femur from a much younger animal. The other bones include skull fragments, mandibles, extremity shafts, innominates and a vertebra. There is no evidence of butchering.

Other Animals The following table includes the animals already discussed and presents a summary of the specifically identifiable pieces by count and by minimum number of individuals (MNI) per species.

TABLE 10

ANIMAL SUMMARY BY COUNT AND MNI

SPECIES	NUMBER OF PIECES	MNI
Bison	687	14
Canid	41*	8
Beaver	23	2
Rabbit/Hare	15	3
Bear	1	1
Badger	1	1
Skunk	1	1
Lynx	1	1
Bald Eagle	1	1
Lampsilis sp.	2	2
Franklin's Ground Squirrel	1	1
Northern Pocket Gopher	5	2

* Six pieces fit to other pieces, giving the total of 35 in Table 9.

The single bear element, the distal half of a femur, was from Area F. It has cut marks anteriorly, posteriorly and medially and, therefore, is definitely part of the cultural assemblage and not a randomly scavenged bone. The remaining animals, badger, skunk, lynx and bald eagle, are represented by one element each. If they were part of the human occupation at the Stott Site, they were not important enough to be found in abundance. Two molluscs identifiable to Lampsilis sp. were present in Area Upper B. The two gophers, Franklin's ground squirrel and the northern pocket gopher, are likely intrusive to the assemblage.

At least one small to medium-sized deer was also part of the faunal assemblage. Unidentifiable birds, fish and molluscs were also present, as well as turtle. These animals, other than bison, likely added variety to the diet of the occupants of the Stott Site, but were not nearly as important to them as the vast amount of bison.

CHAPTER IV

CULTURAL MATERIALS

CERAMICS

With its location in the Aspen Parkland along the western edge of the Northeastern Plains, the Stott Site contains cultural materials that are either absent or relatively rare among bison kill sites further west. Undoubtedly remnants of ceramic vessels are the most abundant of these artifacts. Throughout the 40 years of investigation at DlMa-1, ceramic potsherds have been recovered from all seven subareas of the site (A-G), as well as within the fill of the burial mound itself (Figure 2). Analyses of ceramic materials from DlMa-1 have been variable at best. Detailed reports of some excavations have not been written; others have emphasized nonceramic aspects and, certainly, no one person has ever analyzed all of the Stott ceramic recoveries. Nevertheless, through the years, a majority of the pottery vessels, as defined from rim sections and reconstructions, have been classified as Blackduck by various researchers (Bird 1947; MacNeish 1954; Saylor 1976; Watrall 1976; Tisdale 1978; Syms et al. 1979; Hamilton 1981; Pokotylo and Tisdale 1982).

Although the phrase "Blackduck rimsherd" probably evokes for most analysts the image of a thick, flared rim decorated with cordwrapped object impressions and punctates, in fact considerable variation exists in Blackduck ceramics in Manitoba, both spatially and temporally. Carmichael's (1977) modal analysis of Blackduck ceramics from EgKx-1 on Wanipigow Lake in eastern Manitoba was the first systematic description of large quantities of Blackduck pottery from the province. Utilizing his analysis as a starting point, Tisdale (1978) described 73 vessels recovered prior to 1978 from both the farm and park portions of DlMa-1 and, subsequently, 19 vessels recovered from the park in 1981 (Pokotylo and Tisdale 1982). Hamilton, who recovered 27 new vessels from the farm portion of the site in 1979, placed these within Tisdale's modal system, although he protested the proliferation of variations on the basic modes (1981:71; 175-179).

Hamilton's criticism seems justified in the sense that one would prefer a simple classificatory scheme encompassing the totality of Stott ceramics. Unfortunately, the broad range of ceramics, which in modal analysis is handled by creating variants on basic modes, is a reality at the Stott Site. Perhaps Tisdale's modal system should be revised or scrapped altogether, but until the full range of ceramic variation has been delineated and described, such an action would be premature at best. Certainly it is legitimate to question the apparent great range of variability between Blackduck ceramics at DlMa-1 and elsewhere. If Blackduck at Stott is different from Blackduck at Wanipigow, what do those differences represent? Blackduck ceramics at FbMb-1, the Aschkibokahn Site, 220 km north of DlMa-1 on the west shore of Lake Winnipegosis, not only differ from Wanipigow; they differ from Stott as well (Badertscher 1978).

Even more basic than intersite comparisons, however, are intrasite differences. What is the distribution of the various ceramic modes within subareas of the site? Do the differences that emerge represent temporal variation in ceramic decorative styles of essentially the same people, as Tisdale indicates (1978:100), or do they represent various groups utilizing the site at either the same or different times, as Syms' Co-Influence Sphere Model would suggest (Syms 1977)? Answers to these latter, more specific questions seem crucial for developing an understanding of how, by whom, and when the Stott Site was utilized. To these ends, major emphasis in this report will be placed upon incorporating the 1982 ceramic recoveries within the current modal system and analyzing intrasite distributions for significant differences. Additionally, the 1982 Blackduck ceramics will be compared to the Smith Mound and Village ceramics in Minnesota, where Lugenbeal (1976) identified early and late Blackduck assemblages in radiocarbon-dated contexts.

Ceramic recoveries during the 1982 field season will be discussed in terms of Areas F, located west of the TransCanada Highway on the Stott family farm, and Upper B, located east of the Highway midway up the valley wall in Grand Valley Provincial Recreation Park (Figure 2). These areal distinctions have been devised to facilitate analysis by archaeologists and are, of course, quite artificial, particularly the distinction between materials found east or west of the TransCanada Highway. Prior to construction of the highway in the late 1950s and the park in 1961, the valley wall was unbroken and farming activities were carried on both above and below the wall by the Stott and MacPherson families (Figure 5). In addition to the natural erosional forces that must be considered, both highway and park construction have obviously affected and further complicated interpretation of cultural materials found near or within their borders (Figure 6).

In Area F, a total of 606 ceramic potsherds were recovered from the seven excavation units. Most of these were undecorated bodysherds, usually bearing cord impressions (Table 11). All sherds were placed on tables that had been marked to indicate the depths below surface of their recovery, as well as the position of the bone bed in that particular locale (Figure 44). Once the bodysherds were added to the tables at their appropriate unit and

TABLE 11

AREA F CERAMIC SUMMARY

UNIT	RIMSHERDS	DECORATED BODYSHERDS[a]	BODYSHERDS	TOTAL
99	4	4	115	123
100 + Balk with 99	6	7	165	178
101 + Balk with 100	7	4	94	105
102 + Feature 2	2	4	14	20
103	0	1	0	1
104	0	2	16	18
125	4	13	144	161
TOTAL	23	35	548	606

[a] For simplicity, neck, shoulder and other decorated sherds have been collapsed into one category. Appendix I contains a detailed breakdown of ceramic recoveries by class, unit and level.

level, attempts were made to reconstruct vessels. As previous researchers had discovered, these attempts proved futile with very few exceptions. As a result, the 20 new vessels proposed for Area F have been defined from very small rim sections, obviously an unsatisfactory situation but one not without precedent at DlMa-1 and other sites within the province (Figure 45, Table 12). Undoubtedly the scattered and fragmentary nature of the vessels should be construed as a warning. Soils analyses indicate the generalized eroded character of most of the deposits on or at the base of the valley wall, and ceramic recoveries seem to confirm the confused and probably unreliable context of the cultural deposits as well.

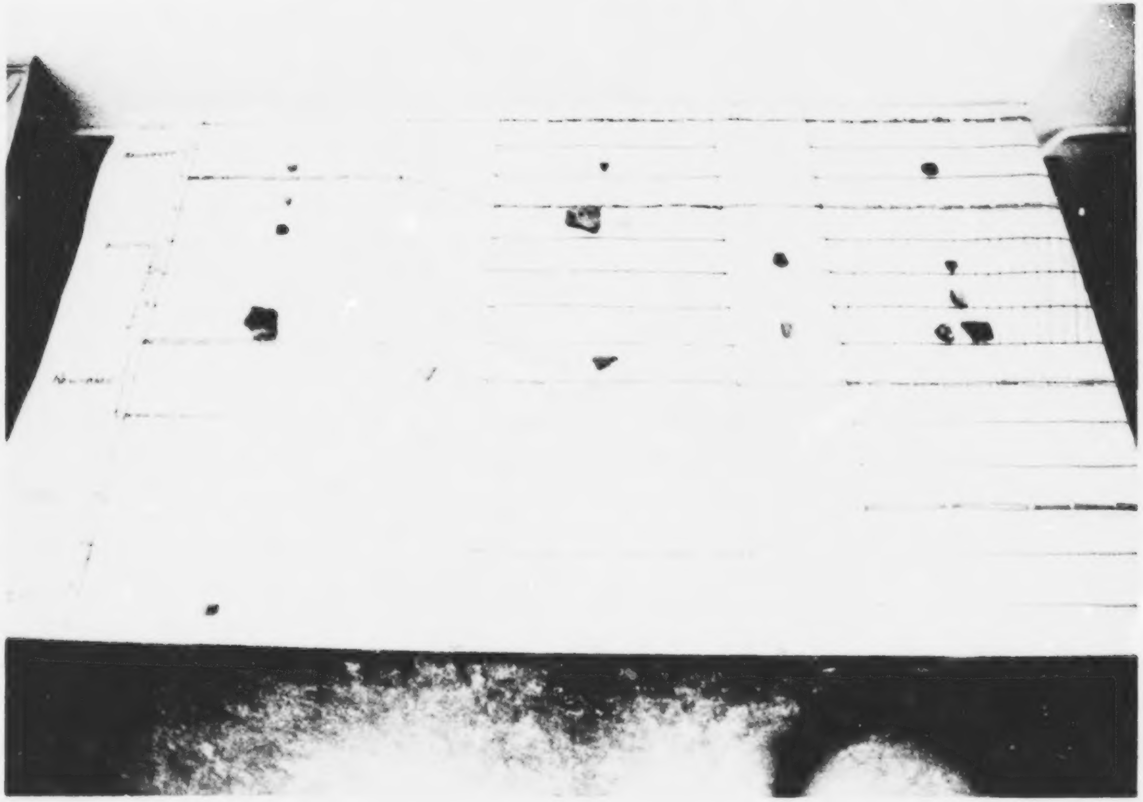


Figure 44. Analysis of ceramics from Units 99, 100 and 101.

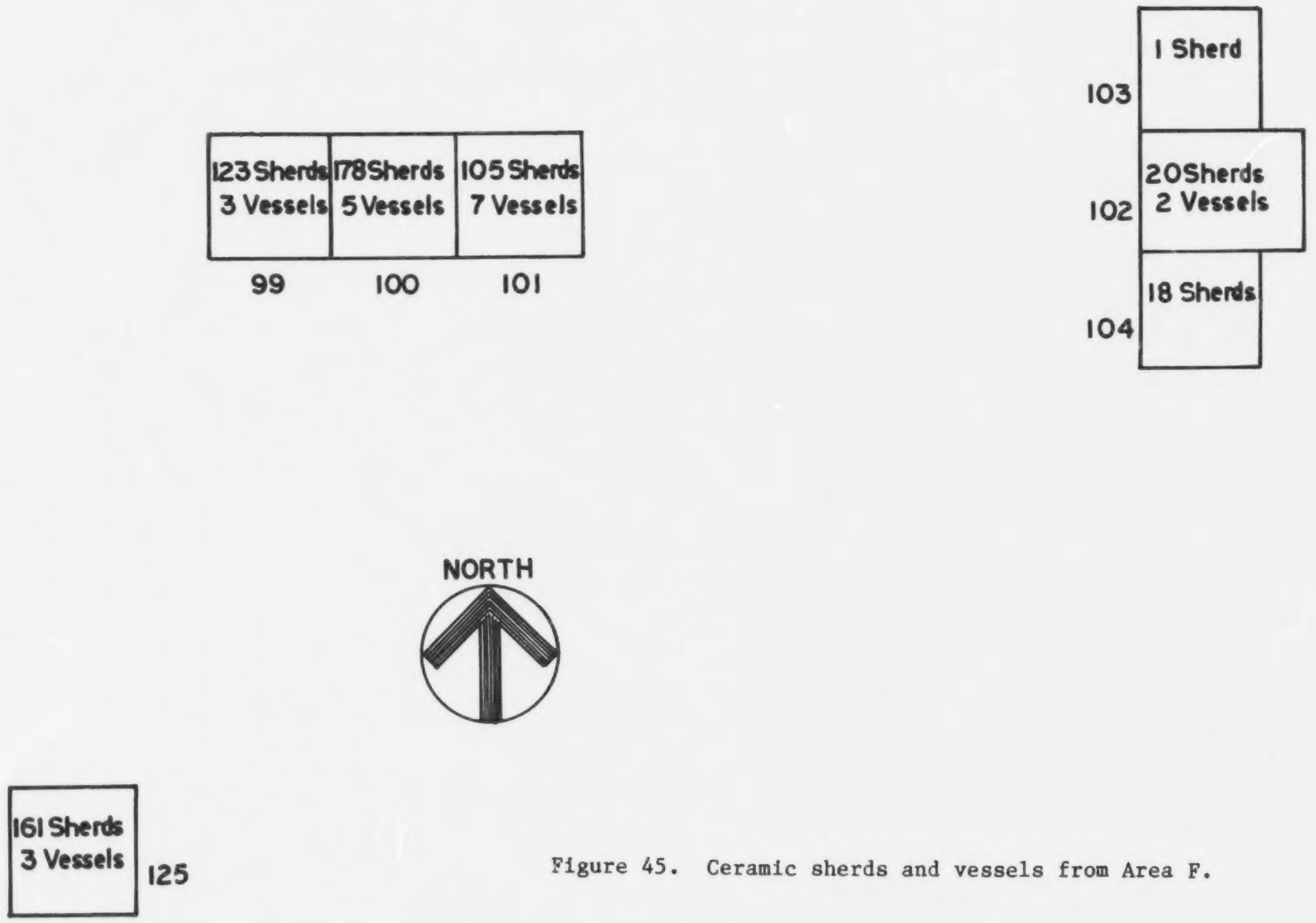

1 Sherd
103
20 Sherds
2 Vessels
102
18 Sherds
104
123 Sherds
3 Vessels
99
178 Sherds
5 Vessels
100
105 Sherds
7 Vessels
101
NORTH
161 Sherds
3 Vessels
125

Figure 45. Ceramic sherds and vessels from Area F.

TABLE 12

AREA F VESSEL TALLY

UNIT	LEVEL	VESSEL	CATALOGUE NUMBERS	TOTAL
99	2	1	99-43	
	3	1	99-84	
	16	1	99-344	3
100 + Balk with 99	2	1	100-42	
	3	1	100-485	
	4	2	100-114; 100-117	
	3	1	100-322	5
101 + Balk with 100	1	1	100-281	
	2	2	101-12; 101-293	
	5	1	101-122	
	6	1	101-173	
	7	2	101-212; 101-213	7
102 + Feature 2	2	1	102-19	
	3	1	102-145	2
125	1	3	125-29; 125-30; 125-31	3
TOTAL VESSELS				20

Although nearly three times as many units were excavated in Upper B as opposed to Area F (20 1x1 metre units in Upper B; six 1x1 metre and one 1x1 1/2 metre units in F), ceramic sherds were recovered in far greater quantities in the latter area. On the average, each 1x1 metre unit in Area F contained 80.8 sherds, while units in Upper B held only 10.4 sherds. Six of the units in Upper B, 105 - 110, contained no pottery at all. A total of 208 potsherds were retrieved from 14 excavation units. Again, most of these were undecorated bodysherds as shown in Table 13.

TABLE 13

AREA UPPER B CERAMIC SUMMARY[a]

UNIT	RIMSHERDS	DECORATED BODYSHERDS	BODYSHERDS	TOTAL
111	0	0	5	5
112	0	1	9	10
113	0	0	7	7
114	1	0	0	1
115	0	0	7	7
116	0	0	3	3
117	3	8	47	58
118 + Balk with 117	2	3	49	54
119	0	0	6	6
120	0	0	14	14
121	0	0	6	6
122	2	1	14	17
123	0	0	12	12
124	0	1	7	8
TOTALS	8	14	186	208

[a] See Appenidx I for details of the ceramic recoveries from Upper B.

Not unexpectedly, vessel reconstruction was limited to the occasional fit. On the basis of very small rim sections, eight vessels were proposed for Area Upper B. Their distribution is presented in Table 14 and Figure 46.

TABLE 14

AREA UPPER B VESSEL TALLY

UNIT	LEVEL	VESSEL	CATALOGUE NUMBERS	TOTAL
114	11	1	114-50	1
117	7	1	117-71	
	8	1	117-103	
	9	1	117-124	3
118 + Balk with 117	2	1	118-118	
	7	1	118-53	2
122	5	1	122-23	
	6	1	122-33	2
TOTAL VESSELS				8

Before placing the 28 vessels recovered during the 1982 field season into the modal system, a brief recapitulation of the ten Blackduck modes is in order. Full explication of the system is located in Tisdale (1978:73-104) and new variations are discussed in Hamilton (1981:71-91). To establish modes for the Stott ceramics, Tisdale followed a three-step process:

> (1) distinguish decorative elements and record their frequencies;
> (2) starting with the most frequent elements, look for the smallest number of these which, as a set, occur on all vessels in the sample;
> (3) finally, add to the set those elements which, though not necessary for creation of the universal set, occur frequently and strongly covary with these "universal elements" (Tisdale 1978:80).

From the 14 primary elements identified, Tisdale's universal set consists of three elements (1978:78; 81): 1) parallel to oblique cordwrapped object

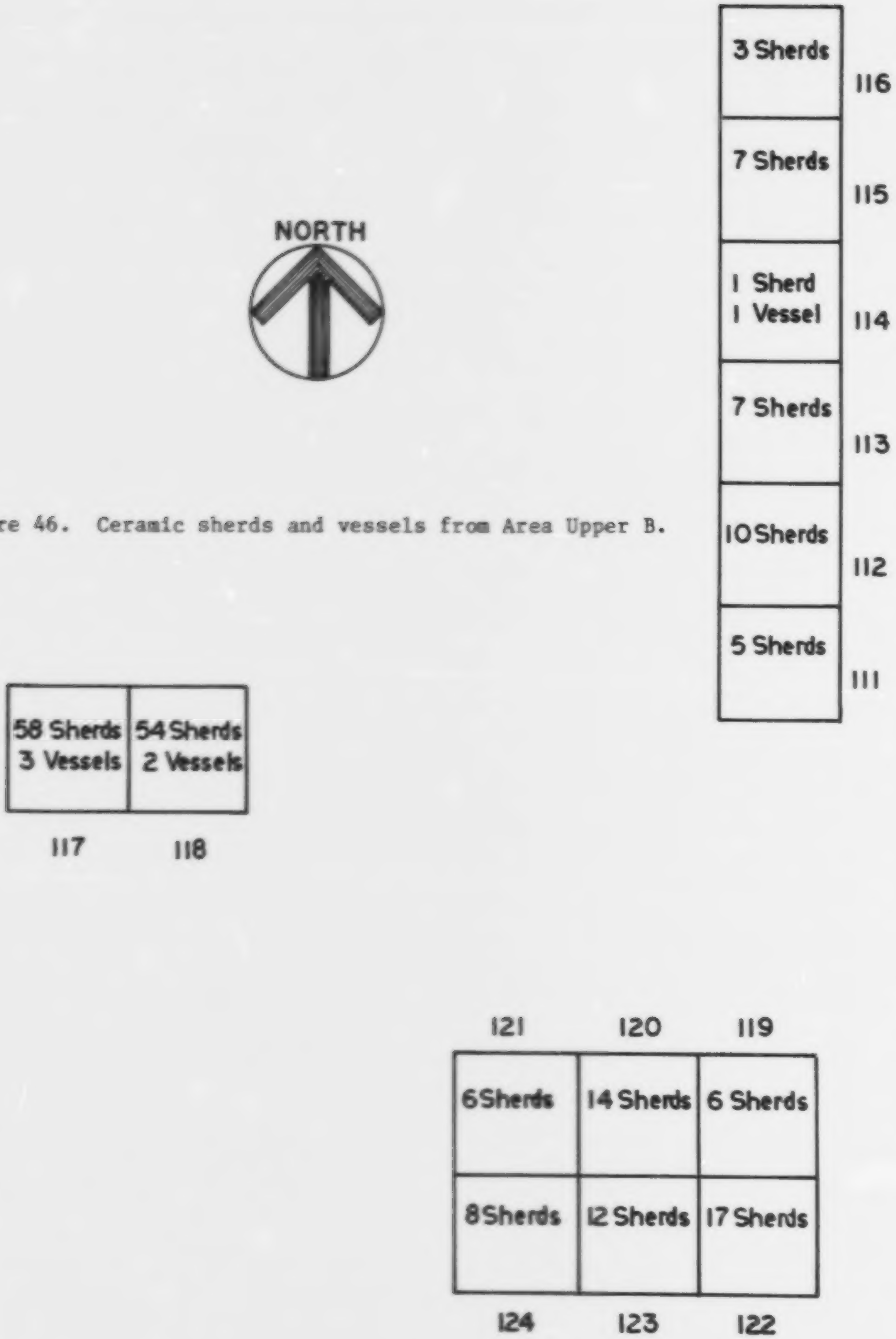

NORTH
3 Sherds
116
7 Sherds
115
1 Sherd
1 Vessel
114
7 Sherds
113
10 Sherds
112
5 Sherds
111
58 Sherds
3 Vessels
54 Sherds
2 Vessels
117
118
121
120
119
6 Sherds
14 Sherds
6 Sherds
8 Sherds
12 Sherds
17 Sherds
124
123
122

Figure 46. Ceramic sherds and vessels from Area Upper B.

impressions on vessel lips; 2) parallel horizontal rows of cordwrapped object impressions on vessel exteriors; and 3) exterior punctates. The remaining elements, in combination with the universal set, comprise the ten modes and their variants. The modes are summarized from Tisdale as follows (1978:86-90); the modes and their variants are illustrated in Figures 47 and 48.

Mode I	Parallel oblique to vertical cordwrapped object impressions on vessel lip and upper rim; parallel horizontal cordwrapped object impressions on upper rim exterior; circular punctates located between the first and second rows of horizontal cordwrapped object impressions.
Mode II	Identical to Mode I, but no punctates present.
Mode III	Identical to Mode I, but no rows of parallel horizontal cordwrapped object impressions.
Mode IV	Identical to Mode I, but no punctates and no rows of parallel horizontal cordwrapped object impressions.
Mode V	Parallel oblique to vertical cordwrapped object impressions on vessel lip; parallel horizontal cordwrapped object impressions on upper rim exterior.
Mode VI:	Parallel oblique to vertical cordwrapped object impressions on vessel lip; exterior punctates on upper rim exterior.

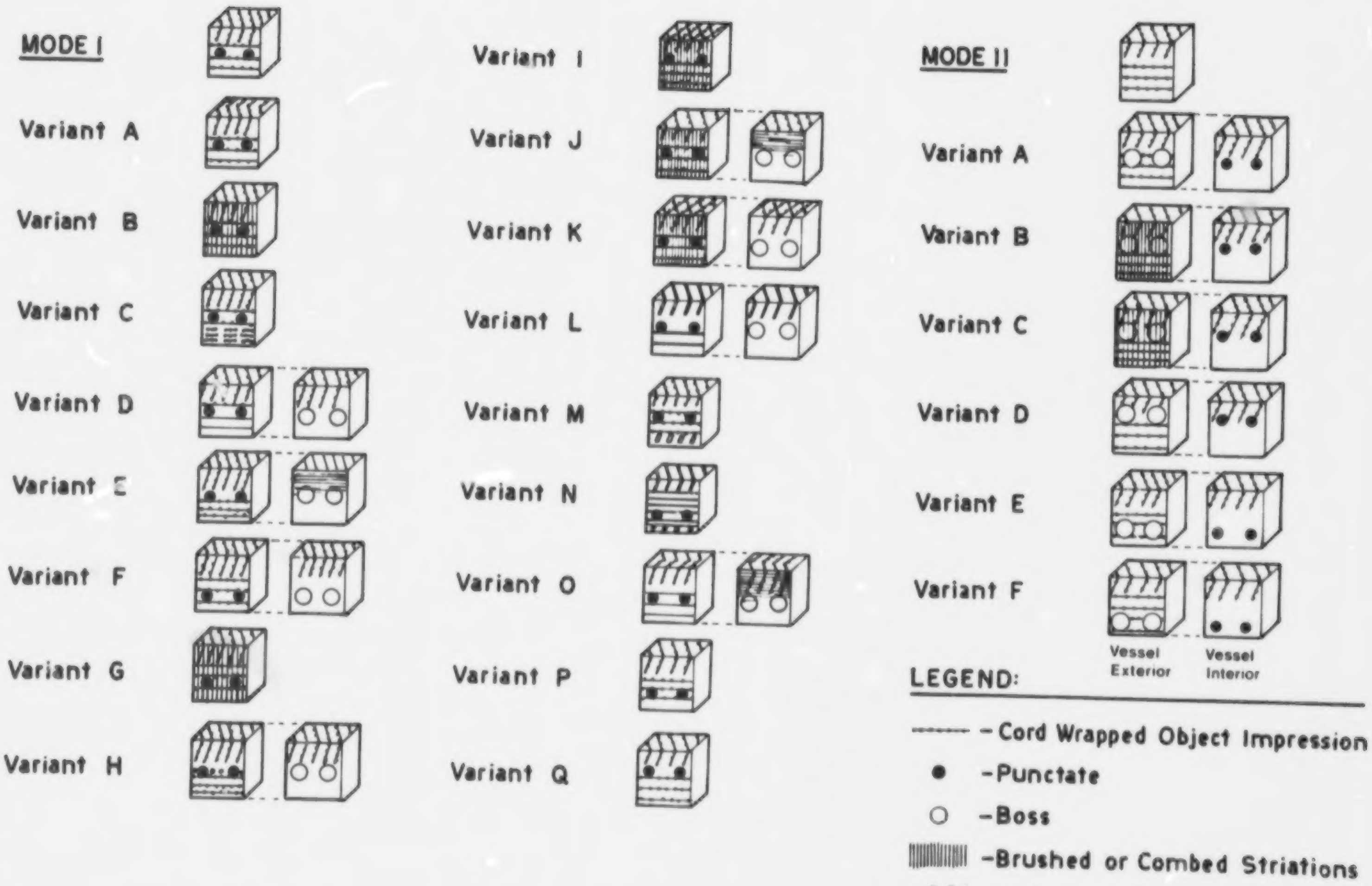

MODE I
Variant A
Variant B
Variant C
Variant D
Variant E
Variant F
Variant G
Variant H
Variant I
Variant J
Variant K
Variant L
Variant M
Variant N
Variant O
Variant P
Variant Q
MODE II
Variant A
Variant B
Variant C
Variant D
Variant E
Variant F
Vessel Exterior
Vessel Interior
LEGEND:
-Cord Wrapped Object Impression
● -Punctate
○ -Boss
-Brushed or Combed Striations
-Incised or Trailed Lines
-Linear Stamps

Figure 47. Blackduck ceramic modes I, II, and variants. Adapted from Hamilton 1981.

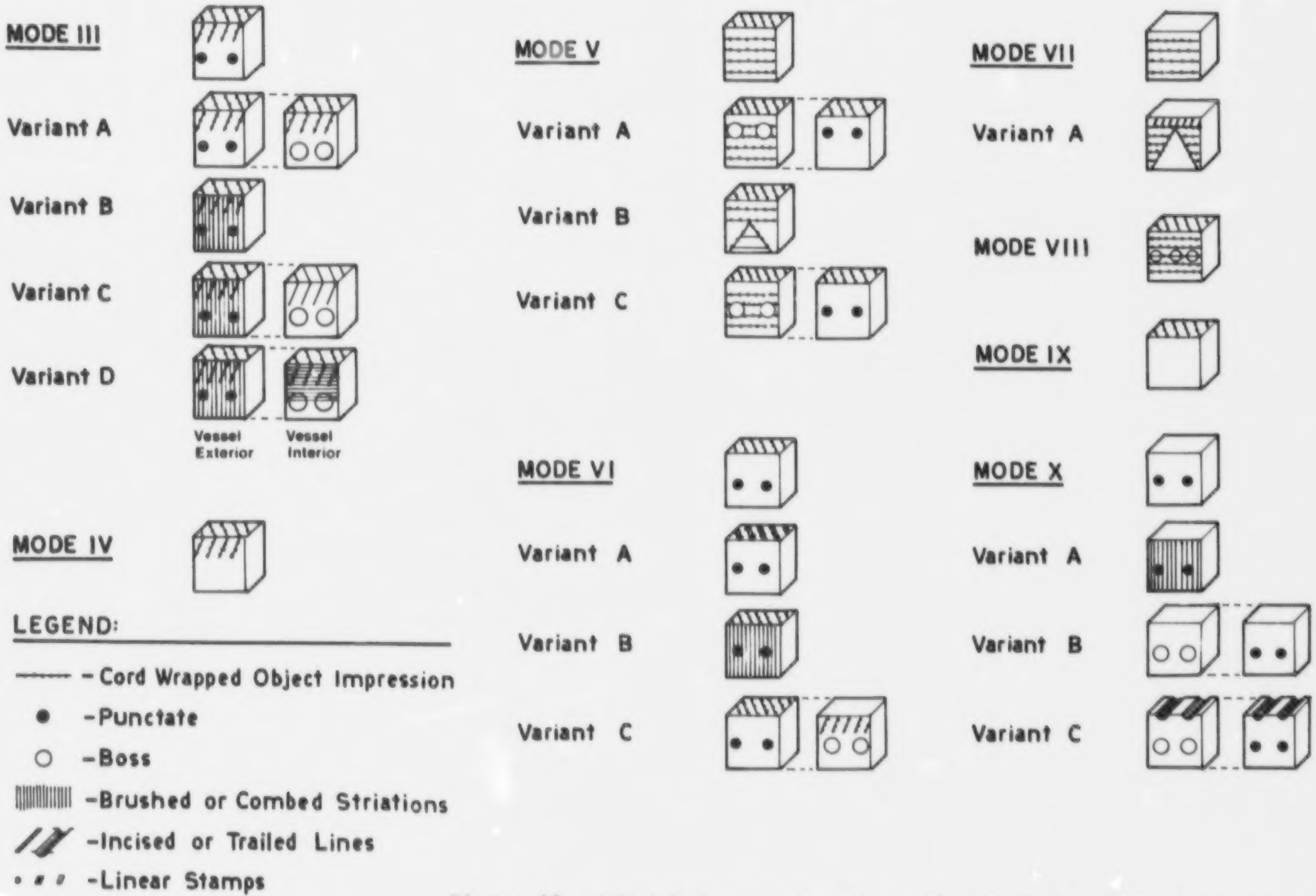

MODE III
Variant A
Variant B
Variant C
Variant D
Vessel Exterior
Vessel Interior
MODE IV
LEGEND:
- Cord Wrapped Object Impression
● -Punctate
○ -Boss
-Brushed or Combed Striations
-Incised or Trailed Lines
-Linear Stamps
MODE V
Variant A
Variant B
Variant C
MODE VI
Variant A
Variant B
Variant C
MODE VII
Variant A
MODE VIII
MODE IX
MODE X
Variant A
Variant B
Variant C

Figure 48. Blackduck ceramic modes III, IV, V, VI, VII, VIII, IX, X and variants. Adapted from Hamilton 1981.

Mode VII: Horizontal cordwrapped object impressions on vessel exterior; no punctates; no exterior obliques; no lip decoration.

Mode VIII: Identical to Mode V with addition of punctates on upper rim exterior.

Mode IX: Parallel oblique to vertical cordwrapped object impressions on vessel lip; no exterior decoration.

Mode X: Circular punctates on vessel exterior; no lip decoration.

Close examination of vessels from the 1982 excavations in Area Upper B reveals that one rim, 117-124, belongs with a reconstructed vessel consisting of rim sections found in 1977 and 1981. This vessel has been designated #17 by Tisdale (Pokotylo and Tisdale 1982) and rim sherd 117-124 has been given that same designation. As 18 vessels had been described for Area Upper B at the close of the 1981 season, the 1982 vessels from Upper B have been numbered serially, starting with #19. To date, then, a total of 25 vessels has been proposed for Area Upper B. The modal classification of Upper B vessels is displayed in Table 15; illustrations are found in Figure 49.

No overlap of rim sections could be discerned for Area F: Hamilton's 27 vessels remained distinct from the 20 recovered in 1982. This occurrence is not unexpected, however. Hamilton's Unit 65 at approximately 11N 93E, located nearest the 1982 excavations, still lay 11 metres north and 10 metres west of the closest of the 1982 units (0N 104E). Several of the 1979 Field School units were in close proximity to the 1982 units, particularly Units 63

TABLE 15

AREA UPPER B VESSELS AND THEIR MODES

VESSEL	CATALOGUE NUMBER	UNIT	MODE AND VARIANT	COMMENTS
19	114-50	114	?	Exterior exfoliated: no determination possible
20	117-71	117	Ie	
21	117-103	117	Ib/IIIb	Rim broken above area of punctates and horizontal banding
17	117-124	117	Xa	Same vessel identified in 1977 and 1981
22	118-118	118	Ib/IIb,c/ IIIb	Rim broken above area of potential punctates and horizontal banding
23	118-53	118	IX	
24	122-23	122	If	
25	122-33	122	Ig	

and 64, as well as Test Pits 4 and 6 (see Figure 8 for location of the 1979 units). Unfortunately, the artifacts from these units were unavailable for study at the time of writing. Including Hamilton's 1979 recoveries, but excluding the unanalyzed 1979 Field School ceramics, a total of 47 vessels has been proposed for Area F. The modal classification for the 1982 vessels is found in Table 16; contrary to Hamilton's experience, only one new variant had to be created to encompass the 20 new vessels (Mode VIc). Illustrations of the 1982 Blackduck vessels are found in Figures 50 and 51.

A comparison of the distribution of Blackduck ceramic modes in Area Upper B and Area F (Figures 52 and 53), reveals an interesting situation. Mode I and its variants dominate numerically in both areas. With the exceptions of Mode II and Mode V, which are limited to Area F, basically the

TABLE 16

AREA F VESSELS AND THEIR MODES

VESSEL	CATALOGUE NUMBER	UNIT	MODE AND VARIANT	COMMENTS
28	99-43	99	III	
29	99-84	99	Unclassified	Design is executed with a dentate stamp and boss; would be IId if only motif considered
30	99-344	99	VI	Recovered from paleosol (IIAhb)
31	100-485	100	Vc	
32	100-42	100	X	
33	100-114	100	I/II/III/IV	Interior of rim exfoliated; precise determination impossible
34	100-117	100	IIIc	
35	100-322	100	Ii/II	If II, would need to add a new variant with cross-hatched lip
36	101-281	101	I/II/III/IV	
37	101-293	101	I/II/III/IV	
38	101-12	101	Unclassified	Design is executed with a dentate stamp and boss; would be a new variant of Mode II if only motif considered
39	101-122	101	IX	
40	101-173	101	Id, f/IIIa	
41	101-212	101	Unclassified	Design is executed with a dentate stamp and boss; would be IIa if only motif considered
42	101-213	101	VIc	A new variant, consisting of cordwrapped object impressions on rim interior, as well as cordwrapped object impressed lips and exterior punctates
43	125-29	125	I	
44	125-30	125	IIIb	
45	125-31	125	I/II	Rim interior exfoliated
46	102-19	102	Unclassified	Design is executed with incisions; would be I/II if only motif considered
47	102-145	102	Ia	

Figure 49. Blackduck vessels from Area Upper B.

(a) Vessel 17, 117-124
(b) Vessel 19, 114-50
(c) Vessel 20, 117-71
(d) Vessel 21, 117-103
(e) Vessel 22, 118-118
(f) Vessel 23, 118-53
(g) Vessel 24, 122-23
(h) Vessel 25, 122-33

a
b
c
d
e
f
g
h
1
2
3
4

Figure 49. Blackduck vessels from Area Upper B.

Figure 50. Blackduck vessels from Area F.

(a) Vessel 28, 99-43
(b) Vessel 30, 99-344
(c) Vessel 31, 100-485
(d) Vessel 32, 100-42
(e) Vessel 33, 100-114
(f) Vessel 34, 100-117
(g) Vessel 35, 100-322

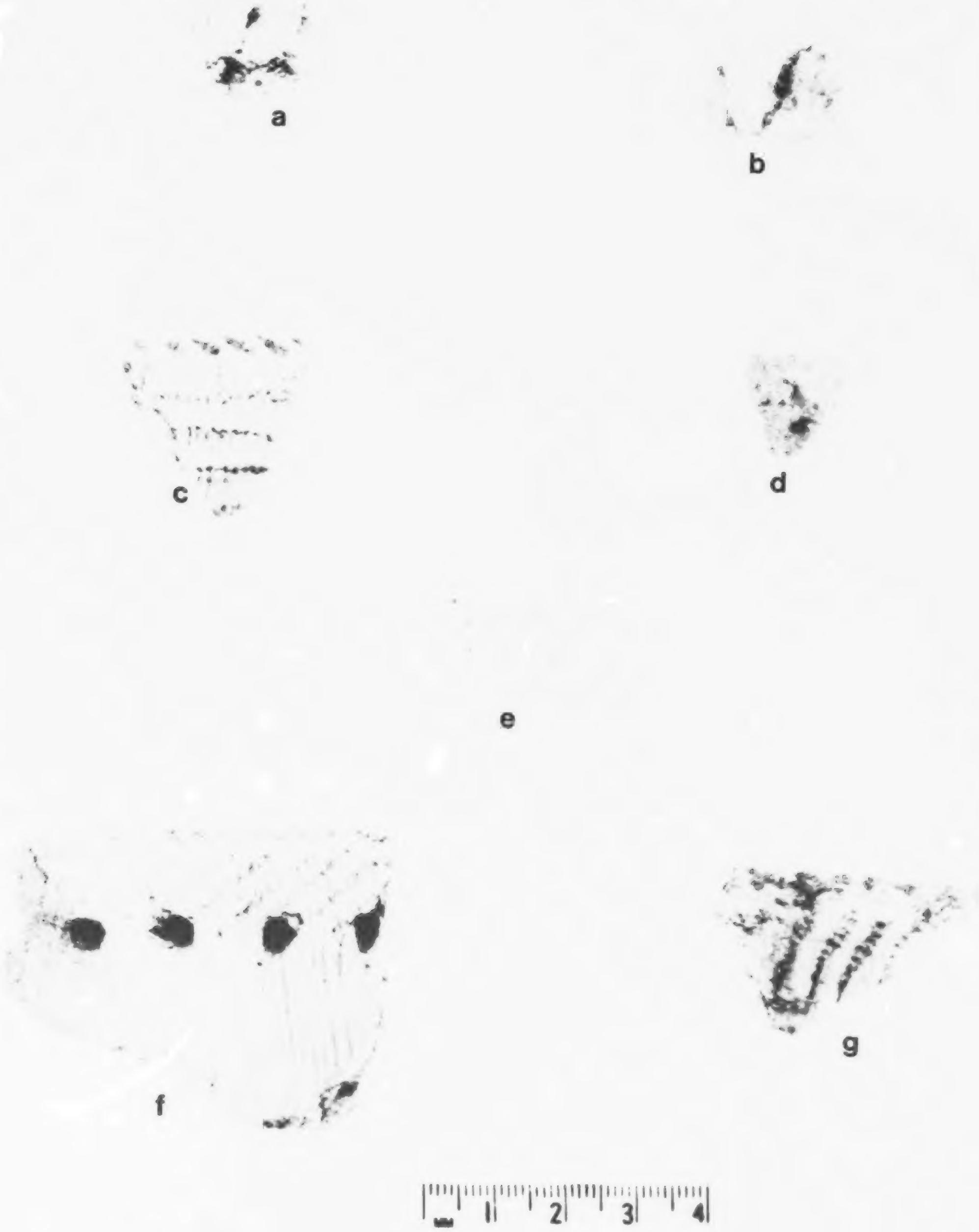

a
b
c
d
e
f
g
1
2
3
4

Figure 50. Blackduck vessels from Area F.

Figure 51. Blackduck vessels from Area F.

(a) Vessel 36, 101-281
(b) Vessel 37, 101-293
(c) Vessel 39, 101-122
(d) Vessel 40, 101-173
(e) Vessel 42, 101-213
(f) Vessel 43, 125-29
(g) Vessel 44, 125-30
(h) Vessel 47, 102-145
(i) Vessel 45, 125-31

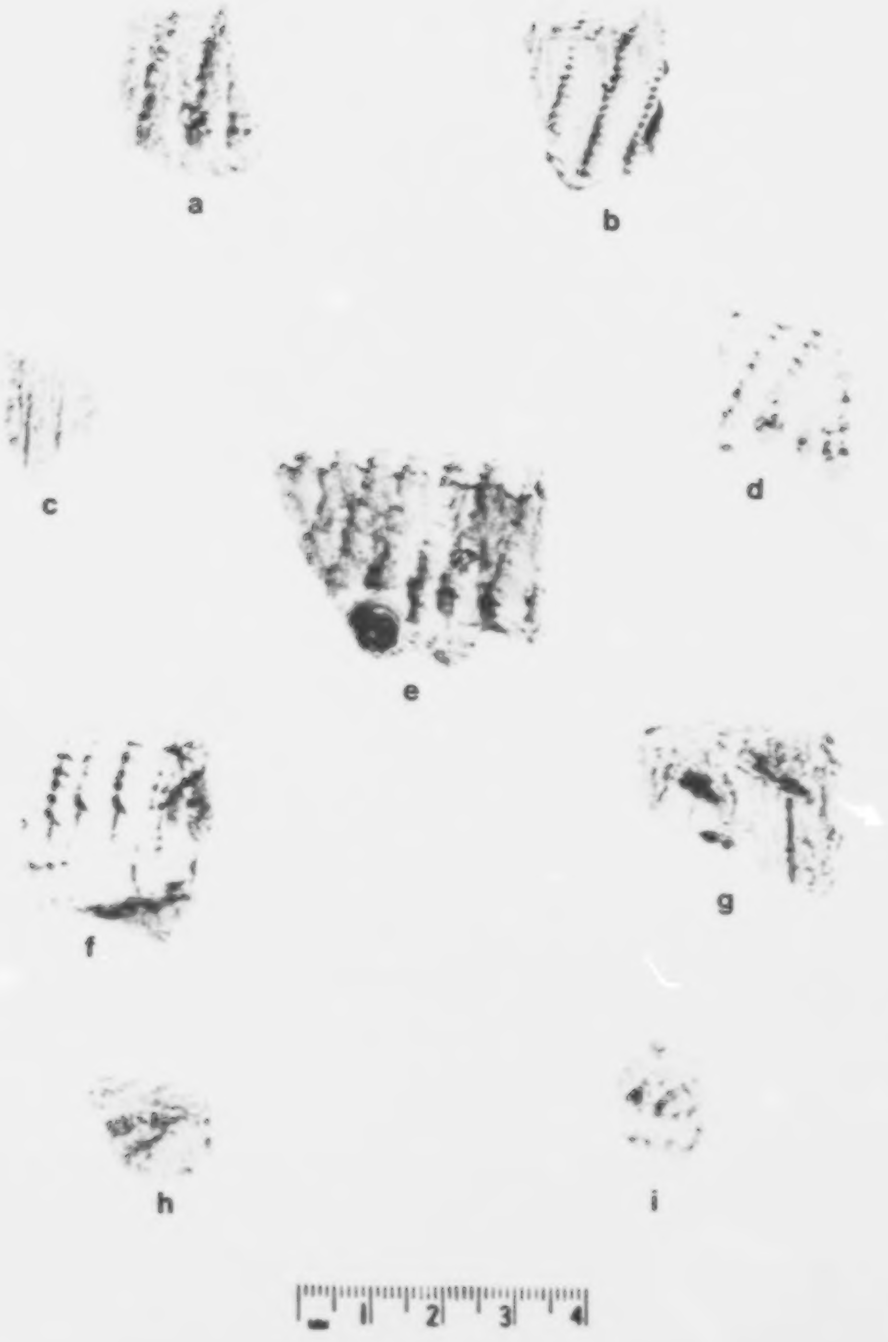

a
b
c
d
e
f
g
h
i
1
2
3
4

Figure 51. Blackduck vessels from Area F.

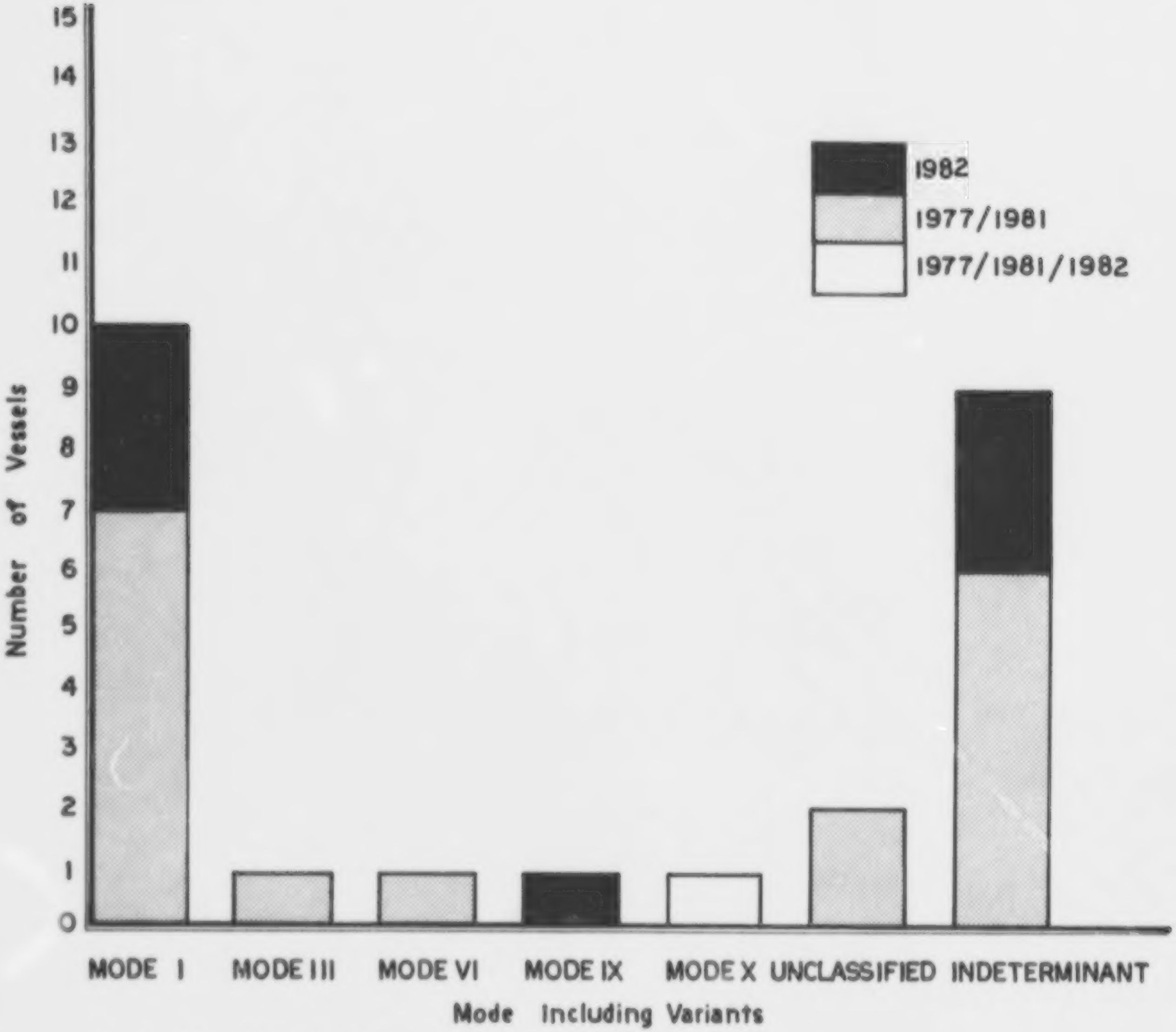


Figure 52. Distribution of ceramic modes in Area Upper B.

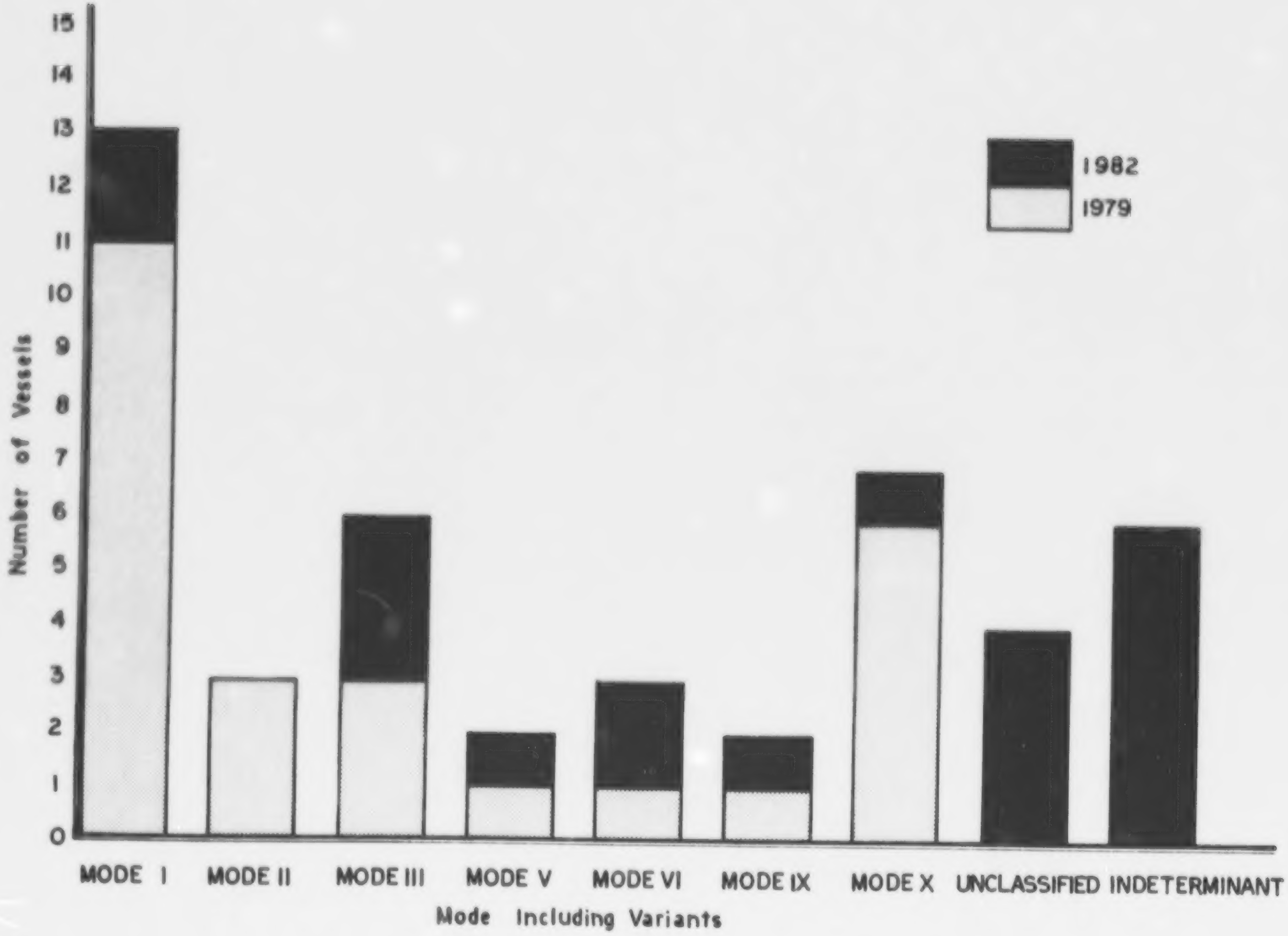


Figure 53. Distribution of ceramic modes in Area F. 1979 data adapted from Hamilton 1981: 87. Note vessel tally for 1979 is 26, not 27 as previously stated.

same modes occur in both areas. If vessels whose modes cannot be determined precisely are eliminated from both areas and comparisons of the modal distributions are then made (Table 17), a somewhat different picture is drawn. Mode I pottery comprises 62.50% of the ceramics in Area Upper B, but only 32.50% in Area F. Mode III vessels appear more than twice as important in Area F, while Mode X vessels occur nearly three times as frequently. Modes VI and IX compare favourably between the two areas, as does the distribution of unclassified vessels which do not fit into the Blackduck typology.

TABLE 17

DISTRIBUTION OF CERAMIC MODES IN AREA UPPER B AND AREA F

	Area Upper B		Area F	
MODE	# VESSELS	% TOTAL	# VESSELS	% TOTAL
I	10	62.50	13	32.50
II	0	0.00	3	7.50
III	1	6.25	6	15.00
V	0	0.00	2	5.00
VI	1	6.25	3	7.50
IX	1	6.25	2	5.00
X	1	6.25	7	17.50
Unclassified	2	12.50	4	10.00
TOTALS	16	100.00	40	100.00

Without a doubt, some of the more interesting ceramics research is contained within Edward Lugenbeal's voluminous study (1976) of Laurel and Blackduck pottery at the Smith Site on the Rainy River near International Falls, Minnesota. In the village debris adjacent to the five burial mounds, Lugenbeal found evidence of "three dark, refuse-bearing strata ... separated by nearly sterile sands" (1976:249). Each stratum contained almost exclusively Blackduck ceramics and Lugenbeal was quick to take advantage of an opportunity to compare relatively pure Blackduck assemblages in datable contexts. Because the lower two strata did not contain quantities of pottery comparable to the third, Lugenbeal collapsed the material recovered from them into one category which he called "Early Blackduck". Recoveries from the third, stratigraphically highest level were termed "Late Blackduck" (1976:250).

Radiocarbon dates from these strata appear to confirm Lugenbeal's contention that Blackduck ceramics are separable into "early" and "late" occupations at the Smith Site (Table 18), although the chronological differences between Early and Late Blackduck are not as striking as Lugenbeal would have one believe. If the appropriate standard deviations are added to the Early Blackduck date (WIS 616) and subtracted from the Late Blackduck dates, then one is faced with a situation in which Late Blackduck is earlier than Early Blackduck in two instances (WIS 611; WIS 613) and only one year older in a third (WIS 615). Even the weighted average of the five "late" dates would only be 50 years younger than the Early Blackduck date.

Despite the problem at the Smith Site, the weighted averages of a series of radiocarbon dates from the park side excavations at the Stott Site in 1977 also seem to demonstrate "at least two Blackduck occupations: around A.D. 800 and A.D. 1200" (Tisdale 1978:100). Two additional assays from the

TABLE 18[a]

RADIOCARBON DATES FROM THE SMITH SITE

LAB NUMBER	TREE RING CORRECTED DATE (MASCA, 1973)	COMPONENT	ADJUSTED DATE	COMMENTS
WIS 616	A.D. 960 ± 88	Early	A.D. 1048	Add Standard deviation
WIS 611	A.D. 1105 ± 96	Late	A.D. 1009	Subtract SD
WIS 613	A.D. 1125 ± 78	Late	A.D. 1047	Subtract SD
WIS 615	A.D. 1130 ± 81	Late	A.D. 1049	Subtract SD
WIS 614	A.D. 1190 ± 74	Late	A.D. 1116	Subtract SD
WIS 612	A.D. 1280 ± 71	Late	A.D. 1209	Subtract SD
Weighted Average	A.D. 1165 ± 67		A.D. 1098	Subtract SD

[a] Adapted from Lugenbeal 1976:602.

1981 excavations in the park (Pokotylo and Tisdale 1982) returned dates of A.D. 850 ± 150 (SFU-229) and A.D. 810 ± 240 (SFU-224), also appearing to confirm an "early" Blackduck occupation. Further evidence for the validity of this "early" Blackduck occupation is found on the farm side, where Syms received dates of A.D. 840 ± 60 (S-1272) and A.D. 910 ± 45 (S-1273) from the base of the bone bed in units excavated by the 1975 Field School in Area G (Syms 1976:30).

Lugenbeal's analysis of the Blackduck ceramics from the "early" and "late" occupations revealed distinct differences between the two groups, which he summarized as follows:

> In the early Blackduck phase at the Smith site vessels were predominately (if not exclusively) cordmarked and paddled. Decoration on the interior rim was common and consisted of a row of typically rather long and probably spaced oblique cordwrapped stick impressions. Lips were

almost always cordwrapped stick stamped, with oblique impressions below the lip nearly universal. Lips were flattened and thickened and ran to beveled-out shapes. Exterior rims and necks were almost always cordwrapped stick decorated with a strong preference for the oblique over horizontal motif. Punctations almost always occurred on the rim as a single row of deep, spaced, circular punctations superimposed on or between the upper two rows of horizontal banding. The "comb-stamped" variety of cordwrapped stick was common, and below the banded motif angled punctates were favored. These punctates were sometimes in the gray area between punctations and stamps.

A distinctive group of vessels in the early phase was the bossed group. Several bossed vessels were represented by large rims. These showed a tendency towards long rims and necks and steeply angled, as opposed to flatter and more squat shoulders. The bossed vessels often had thickened lips, but no thickened rims, and the banded decoration which was associated with the bossing was executed with a "comb" stamp or regular cordwrapped stick, often over an only partially smoothed cordmarked surface.

Brushing occurred on only about a third of the Smith site early phase vessels, but the low frequency of brushing was related to the frequency of bossed vessels which rarely display brushing.

In the late phase vessels were usually not cordmarked or paddled, instead body surfaces were fabric marked. Less than one-fifth of the vessels had interior rim decoration. Nearly all vessels with exterior or stamped decoration also had cordwrapped stick stamped lips. The most common motif was an oblique impression across the lip, but non-oblique motifs occurred on more than 20 percent of the vessels. A rather large number of vessels (31.1 percent) had no exterior decoration. None was bossed, but 10 percent were decorated with punctations but no cordwrapped stick. Banding was rare: instead, the dominant motif was a single row of oblique cordwrapped stick impressions just below the lip with punctates below. Punctates, however, tended to be non-circular, unspaced indentations -- even those on the rim. Brushing was rare, occurring on only 10.5 percent of the vessels and twisted-cord types of cordwrapped stick were favored. Not only did the plain essels have unsmoothed surfaces (except for the crook of the neck), but a number of decorated vessels (18 percent) had unsmoothed non-cordmarked surfaces over which the rim decoration was placed. Vessel shape was probably more squat than in the early phase. Reconstructed pots of the late phase were all small, squat, globular cooking vessels. Lip shape tended to be beveled-in instead of beveled-out (Lugenbeal 1979:28-29).

Unfortunately the Stott Site is not favoured with an internal stratigraphy that promotes much confidence in the stratigraphic relationships of artifacts (see Chapter II). Attempting to separate "early" and "late" Blackduck ceramics on a stratigraphic basis at DlMa-1 seems foolhardy, at best, but considering the similarities in radiocarbon dates at the two sites, it should be possible to favourably compare Stott and Smith Site Blackduck ceramics. Presumably, Stott Blackduck ceramics will be divisible into "early" and "late" groups on the basis of attributes identified as significant by Lugenbeal. An exception to this assumption may occur in Area F, however. The two radiocarbon dates from the farm portion of the site were obtained from Area G (see Figure 2). Although they do indicate an "early" occupation, that does not necessarily mean that Area F contains either an "early" or "late" Blackduck occupation. Matters are somewhat different in the park. Three radiocarbon dates have been obtained for Area Upper B. The 1977 dates, A.D. 1170 ± 105 (GX 5175) and A.D. 1210 ± 105 (GX 5174), indicate a "late" occupation, while the 1981 date, A.D. 850 ± 150 (SFU-229) an "early" occupation. Consequently, one would reasonably expect both "early" and "late" Blackduck vessels to be present in Area Upper B.

The first subgroup of ceramics to be investigated is that of undecorated bodysherds. Lugenbeal found 82.7% of all the bodysherds he designated Early Blackduck stratigraphically to be cordmarked; only 33.9% of Late Blackduck sherds were cordmarked. If he used only the bodysherds recovered from the three distinct strata, percentages rose to 93.6% cordmarked in Early Blackduck, compared with 23% cordmarked in Late Blackduck (Lugenbeal 1976:251). When the undecorated bodysherds recovered in 1982 at DlMa-1 were examined for surface treatment, they paralleled Lugenbeal's findings for the

Early Blackduck strata. In Table 19, an analysis of identifiable undecorated bodysherds from the units in Area F confirms their assignment to an "early" Blackduck occupation. In Area Upper B, the data also indicate an "early" Blackduck occupation, although percentages there are not nearly so striking (Table 20). Units 119-124 appear unique, with only 68.18% of the bodysherds cordmarked and some 27.27% smoothed. In general, however, on the basis of undecorated bodysherds alone, it would appear that Areas F and Upper B primarily contain "early" Blackduck cultural materials.

TABLE 19[a]

UNDECORATED BODYSHERDS - AREA F

UNITS	IDENTIFIABLE BODYSHERDS	CORDMARKED		FABRIC-MARKED		SMOOTHED	
		#	%	#	%	#	%
All units	311	262	84.24	20	6.43	29	9.33
99, 100, 101	219	178	81.28	18	8.22	23	10.50
99, 100, 101, 125	284	237	83.45	20	7.04	27	9.51
125	65	59	90.77	2	3.08	4	6.15
102, 104	27	25	92.59	0	0.00	2	7.41

[a] Attributes used in this and subsequent analyses are found in Appendix II; data from the analyses are contained in Appendix III.

TABLE 20

UNDECORATED BODYSHERDS - AREA UPPER B

UNITS	IDENTIFIABLE BODYSHERDS	CORDMARKED		FABRIC-MARKED		SMOOTHED	
		#	%	#	%	#	%
All units	150	117	78.00	16	10.67	17	11.33
111-118	106	87	82.07	14	13.21	5	4.72
111-116	27	21	77.78	4	14.81	2	7.41
117, 118	79	66	83.54	10	12.66	3	3.80
119-124	44	30	68.18	2	4.55	12	27.27

When the attributes measured on the Stott rimsherds were compared with those from the Smith Site, however, the results are not nearly so clear-cut as those obtained on the undecorated bodysherds. Lugenbeal had originally measured 48 attributes on Smith Site rimsherds, but prior to testing his results for significance with a X^2 statistic, he eliminated 29 of the attributes on the basis of inadequate sample size, universal or single occurrence, or difficulty in replicating the measurements. For the remaining attributes,

> A chi square statistic was calculated for each qualitative variable to see if the difference in the distribution of values among the attribute states in the early and late Blackduck levels should be attributed to chance. To overcome small sample size related categories were collapsed, leaving usually just two states for each attribute (Lugenbeal 1976:259).

Table 21 contains the numerical and percentage calculations for those attributes that Lugenbeal found to be significantly different at the .05 level between "early" and "late" Blackduck rimsherds, as well as the same measurements for the rimsherds recovered in 1982 from the Stott Site.

TABLE 21[a]

COMPARISON OF SMITH AND STOTT SITES BLACKDUCK CERAMIC RIMSHERD ATTRIBUTES

		SMITH SITE				STOTT SITE			
Attribute	Attribute State	Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%[b]	#	%	#	%	#	%
Lip Shape	Beveled Out	8	34.8	11	12.8	14	66.7	1	12.5
	Beveled In	4	17.4	43	50.0	1	4.8	4	50.0
	Symmetrical	11	47.8	32	37.2	6	28.6	3	37.5
	Unidentifiable	4	-	13	-	2	-	0	-
		27	100.0	99	100.0	23	100.1	8	100.0
Interior Rim Decoration	Decorated	18	58.1	32	26.4	6	31.6	2	28.6
	Undecorated	13	41.9	89	73.6	13	68.4	5	71.4
	Unidentifiable	6	-	13	-	4	-	1	-
		37	100.0	134	100.0	23	100.0	8	100.0
Lip Decorative Motif	Oblique	23	92.0	61	78.2	17	81.0	5	71.4
	Nonoblique	2	8.0	17	21.8	4	19.0	2	28.6
	Unidentifiable/ Undecorated	12	-	56	-	2	-	1	-
		37	100.0	134	100.0	23	100.0	8	100.0

Attribute	Attribute State	SMITH SITE				STOIT SITE			
		Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%	#	%	#	%	#	%
Exterior Rim Decoration	CW01 Only	4	15.4	10	11.4	5	23.8	2	28.6
	Punctates Only	0	0.0	11	12.5	3	14.3	1	14.3
	CW01 & Punctates	13	50.0	40	45.5	7	33.3	3	42.9
	CW01 & Boss	8	30.8	0	0.0	1	4.8	0	0.0
	Dentate Stamp & Boss^c	0	0.0	0	0.0	3	14.3	0	0.0
	Incisions^c	0	0.0	0	0.0	1	4.8	0	0.0
	No Decoration	1	3.8	27	30.7	1	4.8	1	14.3
	Unidentifiable	11	-	46	-	2	-	1	-
		37	100.0	134	100.0	23	100.1	8	100.1
Exterior Decorative Motif	Oblique/Horizontal	15	68.2	24	38.1	6	37.5	0	0.0
	Oblique Only	5	22.7	33	52.4	7	43.8	3	60.0
	Horizontal Only	1	4.5	4	6.3	1	6.3	0	0.0
	Interrupted O/H	1	4.5	0	0.0	0	0.0	0	0.0
	Herringbone O/H	0	0.0	1	1.6	0	0.0	0	0.0
	Complex Banded	0	0.0	1	1.6	0	0.0	0	0.0
	Vertical/Horizontal^c	0	0.0	0	0.0	2	12.5	2	40.0
	Punctated Only	1	-	35	-	5	-	2	-
	Unidentifiable	4	-	1	-	2	-	1	-
		27	99.9	99	100.0	23	100.1	8	100.0

Attribute	Attribute State	SMITH SITE				STOTT SITE			
		Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%	#	%	#	%	#	%
Bosses/ Punctates	Punctate	11	45.8	53	60.2	9	45.0	4	57.1
	Boss	8	33.3	0	0.0	5	25.0	0	0.0
	Neither	5	20.8	35	39.8	6	30.0	3	42.9
	Unidentifiable	3	-	11	-	3	-	1	-
		27	99.9	99	100.0	23	100.0	8	100.0
Type Punctates	Circular	10	90.9	20	37.7	5	55.6	3	80.0
	Noncircular	1	9.1	31	58.5	4	44.4	1	20.0
	Combination	0	0.0	2	3.8	0	0.0	0	0.0
	No Punctates	16	-	46	-	14	-	4	-
		27	100.0	99	100.0	23	100.0	8	100.0
Punctate Spacing	Spaced (5 mm)	10	90.9	13	30.2	3	75.0	4	100.0
	Close (5 mm)	1	9.1	27	62.8	1	25.0	0	0.0
	Combination	0	0.0	2	4.7	0	0.0	0	0.0
	Zoned	0	0.0	1	2.3	0	0.0	0	0.0
	No Punctates	13	-	46	-	11	-	3	-
	Unidentifiable	0	0.0	0	0.0	8	-	1	-
		24	100.0	89	100.0	23	100.0	8	100.0

Attribute	Attribute State	SMITH SITE				STOTT SITE			
		Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%	#	%	#	%	#	%
Relation B/P to Motif	Superimposed	12	70.6	12	27.9	6	42.9	2	50.0
	Not Superimposed	5	29.4	31	72.1	8	57.1	2	50.0
	Unidentifiable	10	-	56	-	9	-	4	-
		27	100.0	99	100.0	23	100.0	8	100.0
Brushing	Present	8	26.7	13	11.1	3	15.0	2	28.6
	Absent	22	73.3	104	88.9	17	85.0	5	71.4
	Unidentifiable	7	-	17	-	3	-	1	-
		37	100.0	134	100.0	23	100.0	8	100.0
Type CW01	Twisted Cord	18	56.2	65	82.3	11	68.8	4	57.1
	Pseudo Cord	14	43.8	14	17.7	5	31.2	3	42.9
	Unidentifiable/ No CW01	5	-	55	-	7	-	1	-
		37	100.0	134	100.0	23	100.0	8	100.0
Rim/Neck Surface Treatment	Smoothed	23	88.5	63	63.6	12	66.7	3	60.0
	Cordmarked	3	11.5	8	8.1	6	33.3	2	40.0
	Fabric	0	0.0	28	28.3	0	0.0	0	0.0
	Unidentifiable	1	-	0	-	5	-	3	-
		27	100.0	99	100.0	23	100.0	8	100.0

[a] Smith Site data adapted from Lugenbeal 1976:261-266.
[b] Unidentifiable or nonapplicable specimens not used to calculate percentages.
[c] Attribute state found only on Stott rimsherds.

As suspected from the radiocarbon dates, the rimsherds recovered in Area Upper B within Grand Valley Provincial Recreation Park demonstrate affinities with both the Early and Late Blackduck groupings at the Smith Site. Lip shape distributions are practically identical in Late Blackduck and Area Upper B: 50% beveled in, 37% symmetrical, and 12% beveled out. Interior rim decoration and lip decorative motif percentages are also quite similar between Late Blackduck and Area Upper B rims. The distribution of exterior rim decorative elements in Upper B is more like Late than Early Blackduck; the primary difference appears to be 15% of the sample which is decorated with cordwrapped stick only in Upper B, but is undecorated in the Smith Site Late Blackduck levels. Exterior decorative motifs also differ somewhat (there are no vertical/horizontal motifs at the Smith Site), but again, Upper B more closely resembles Late than Early Blackduck. The rims from these two groups also resemble one another in that bossing is not present as a decorative element on either.

However, the remaining attributes that Lugenbeal found to be significant indicate connections between Area Upper B and Early Blackduck. Punctates are overwhelmingly circular and spaced at least 5 mm apart; one-third of the rims are brushed; 40% of the cord impressions are of the "pseudo" (notched tool?) type; and no rims exhibit fabric-impressed exteriors.

Ceramics from Area F, west of the highway and within the farm portion of the site, also exhibit characteristics of both Early and Late Blackduck groups at the Smith Site. Like Upper B, Area F shares the Late Blackduck characteristic of undecorated interior rims. Exterior rim decoration is also more similar to Late than Early Blackduck, but Area F contains more variation in this category than Upper B; 14% of the rims are dentate stamped and bossed (a decorative element unique to Area F), while 4.8% are incised. Neither of these decorative elements appear in Smith Site Blackduck levels. Exterior motifs are also similar between the groups, with the vertical/horizontal motif present in Area F as well as Upper B, but again not at the Smith Site. Other Late Blackduck traits include the nonsuperimposition of punctates onto the exterior motif, fewer brushed rims and fewer "pseudo" cord impressions.

Early Blackduck characteristics shared by Areas Upper B and F are the use of circular, spaced punctates and the absence of fabric impressed rims. Other early Blackduck attributes shared between Area F and the Smith Site are a preponderance of oblique lip motifs and the presence of bossing as a decorative element. Lip shape in Area F rim sherds seems more highly beveled out than in the Early Blackduck counterparts at the Smith Site. Despite these favourable comparisons, however, on the basis of rimsherd attributes without any reliable stratigraphic data, it is impossible to state much about the distribution of Early and Late Blackduck ceramics in Areas Upper B and F of the Stott Site, other than to confirm the presence of both groupings in both areas of the site.

When Lugenbeal examined his sample of decorated bodysherds from the Early and Late Blackduck strata at the Smith Site, he found six attributes to be significant indicators of differences between the two groups (1976:268). Table 22 presents Lugenbeal's findings, along with comparable data from Areas Upper B and F of the Stott Site. Because fewer vessels have decorated exteriors in Late Blackduck, one would expect Early Blackduck to demonstrate a higher percentage of cord impressions on decorated bodysherds. This assumption is confirmed by Lugenbeal's data and Stott decorated bodysherds from both areas also show affinities with Early Blackduck. Also associated

TABLE 22[a]

COMPARISON OF SMITH AND STOTT SITES BLACKDUCK DECORATED BODYSHERD ATTRIBUTES

		SMITH SITE				STOTT SITE			
Attribute	Attribute State	Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%[b]	#	%	#	%	#	%
Cordwrapped Object Impression	Present	30	62.5	64	34.6	22	62.9	12	85.7
	Absent	18	37.5	121	65.4	13	37.1	2	14.3
		48	100.0	185	100.0	35	100.0	14	100.0
Type of Cordwrapped Object	Twisted	13	43.3	49	76.6	12	57.1	9	81.8
	Pseudo	17	56.7	15	23.4	6	28.6	2	18.2
	Paddle Edge[c]	0	0.0	0	0.0	3	14.3	0	0.0
	Unidentifiable/ No CWOI	18	-	121	-	14	-	3	-
		48	100.0	185	100.0	35	100.0	14	100.0
Brushing	Present	17	35.4	32	17.3	5	14.3	7	50.0
	Absent	31	64.6	153	82.7	30	85.7	7	50.0
		48	100.0	185	100.0	35	100.0	14	100.0

		SMITH SITE				STOTT SITE			
Attribute	Attribute State	Early Blackduck		Late Blackduck		Area F		Area Upper B	
		#	%	#	%	#	%	#	%
Use of Boss and Punctate	Punctate	18	94.7	136	100.0	16	94.1	9	100.0
	Boss	1	5.3	0	0.0	1	5.9	0	0.0
	Neither	29	-	49	-	18	-	5	-
		48	100.0	185	100.0	35	100.0	14	100.0
Type Punctate	Circular Spaced	9	50.0	13	9.6	3	18.8	3	33.3
	Indentations	9	50.0	120	88.2	13	81.2	6	66.7
	Combinations	0	0.0	3	2.2	0	0.0	0	0.0
	No Punctates	30	-	49	-	19	-	5	-
		48	100.0	185	100.0	35	100.0	14	100.0
Multiple Rows Punctates	Present	2	11.1	60	44.1	15	93.7	8	88.9
	Absent	16	89.9	76	55.9	1	6.3	1	11.1
	No Punctates	30	-	49	-	19	-	5	-
		48	100.0	185	100.0	35	100.0	14	100.0

[a] Smith Site data adapted from Lugenbeal 1976:169-70.

[b] Unidentifiable or nonapplicable specimens not used to calculate percentages.

[c] Attribute state found only on Stott decorated bodysherds.

with this attribute is the type of cordwrapped object impression. Again, Early Blackduck decorated bodysherds should demonstrate higher percentages of "pseudo" cord impressions, as they do at the Smith Site. These findings are not duplicated by the Stott decorated bodysherds, however; in both areas there is a high incidence of regular twisted cord impressions. In addition, in Area F, 14.3% of the sample demonstrates large, coarse paddle edge impressions, which do not appear at all on Smith Site decorated bodysherds.

In Lugenbeal's rimsherd analysis, brushing and the use of bosses were two attributes strongly indicative of Early Blackduck; decorated bodysherds also support these findings at the Smith Site. For the attribute of brushing at the Stott Site, Area Upper B decorated bodysherds appear to represent Early Blackduck, but Area F sherds are more similar to Late Blackduck distributions. The reverse is true for the attribute of punctate/boss, however. Here Area F more closely resembles Early Blackduck, while Upper B is more like Late Blackduck.

Punctates were also good indicators of "early" and "late" groups at the Smith Site, with Early Blackduck most often exhibiting a single row of circular, spaced punctates; Late Blackduck emphasized noncircular punctates in multiple rows. Lugenbeal's decorated bodysherds were consistent with his rimsherd findings. At the Stott Site, however, decorated bodysherds from both areas indicate the predominance of Late Blackduck ceramics on the basis of punctates. From decorated bodysherds, one can only say that both chronological groupings are represented in the ceramic recoveries at the Stott Site.

Lugenbeal concluded his analysis of Smith Site Blackduck ceramics with a reappraisal of the rimsherds. He tested the significance, at the .01

level, of the interrelationships "between the 12 attributes and 42 attribute states whose historical or cultural importance was suggested by the stratigraphic analysis" (1976:276). As bodysherd attributes could not be assigned to "early" or "late" vessels with much certainty, they were not used in this final step. Eighteen attributes were identified with "significant" positive dependent relationships (Lugenbeal 1976:278). Lugenbeal grouped these 18 attributes into five clusters (see Table 23).

> Each cluster consists of attribute states that have the same, or nearly the same, dependent relationships with other attribute states and are thus highly intercorrelated. ... The few differences visible are differences of degree, not kind. In other words, there are no mutually exclusive dependent relationships in the cluster.
>
> One point highlighted by the attribute clusters is the basic duality of the sample. Clusters 1 and 2 overlap extensively in their attribute associations, but there is little or no overlap with Clusters 3-6, in which most of the attribute states are the opposites of the attribute states characteristic of Clusters 1 and 2. It is likely that the cord-marked and non-cord-marked body surface treatments are closely allied with this duality. We can, therefore, speak of two series of types in our sample. The two series are closely correlated with different strata in the site -- Clusters 1 and 2 with the early Blackduck levels, and Clusters 3-6 with the late Blackduck levels (Lugenbeal 1976:279).

Four of Lugenbeal's clusters correlate positively with types suggested by Evans (1961) in his earlier attempt at Minnesota Blackduck typology: 1 = Osufsen Cord and Punctate; 2 = Osufsen Boss and Cord; 4 = Nett Lake Plain; 5 = Shocker Horizontal Cord. However, Lugenbeal found that Evans' reliance on only two attributes (decorative motif and punctates) to discriminate types insufficient for describing the variation present in Smith Site vessels.

> Evans' types are based on two attributes -- exterior motif and punctate use. The basic division between plain vessels and vessels decorated with banded and oblique

TABLE 23[a]

SMITH SITE BLACKDUCK CLUSTERS

---

1. Early Blackduck
   A. Cluster 1 (Osufsen Cord and Punctate)
      Pseudo cordwrapped object impressions
      Brushing
      Banded motif
      Interior rim decoration
      Beveled-out lip
      Superimposed punctates or bosses
      Oblique lip motif
   B. Cluster 2 (Osufsen Boss and Cord)
      Bossing
      No brushing
      Pseudo cordwrapped object impressions
      Banded motif
      Interior rim decoration
      Beveled-out lip
      Superimposed punctates or bosses
      Oblique lip motif

II. Late Blackduck
   A. Cluster 3
      Oblique motif
      Noncircular punctates
      Nonsuperimposed punctates
      Beveled-in lip
      Plain interior rim
      Twisted cord cordwrapped object impressions
   B. Cluster 4 (Nett Lake Plain)
      Plain exterior
      No bosses or punctates
      Plain interior
      No brushing
   C. Cluster 5 (Shocker Horizontal Cord)
      Exterior rim decorated
      Horizontal motif
      No bosses or punctates
      No brushing
      Twisted cord cordwrapped object impressions
   D. Cluster 6
      Exterior decoration, but only punctates
      Punctates noncircular and unspaced
      No brushing
      Plain interiors

---

[a] Adapted from Lugenbeal 1976:287-288

> motifs seems usable. But the manner in which the banded vessels have been divided into five types is not supported by our data. The typology also fails to subdivide unbanded vessels satisfactorily. It does not discriminate between the noncircular unspaced and circular spaced punctations found with the oblique motif, and it defines a punctated type (Mud Lake Punctate) with no reality at the Smith Site. (I have not been able to identify this type in other Minnesota Blackduck collections either.)
>
> Within the banded types the failure to recognize pseud-cord-wrapped stick and its strong suite of dependent relationships is a major weakness (Lugenbeal 1976:280).

Of vital interest to this study, of course, is the relationship of Stott Blackduck vessels to the clusters derived by Lugenbeal from the Smith Site data. Tables 24 and 25 demonstrate how the vessels recovered from Areas Upper B and F in 1982 fit within the proposed six clusters. Two observations can be made about these data from only a brief look at the tables. Perhaps the most noticeable characteristic is that, with the exception of Clusters 4 and 6, there are no direct correspondences between Smith Site and Stott Site vessels. No doubt, even these correspondences can be attacked on the basis that there are very few variables involved and these are largely negative (4 = no interior/exterior decoration, no punctates/bosses, no brushing; 6 = no interior decoration, punctates only, no brushing). Secondly, when vessels from various horizontal locations within each area are examined (see Figures 8 and 9), contrary to expectations, there are no obvious Early or Late Blackduck concentrations (Table 26). The vessels themselves, it seems, just like the individual attributes denoting Early and Late Blackduck, are scattered throughout Areas Upper B and F in apparently random fashion.

TABLE 24

COMPARISON OF STOTT AND SMITH SITES BLACKDUCK TYPES - AREA UPPER B

VESSEL NUMBER	CATALOGUE NUMBER	STOTT MODE	SMITH CLUSTER	COMMENTS[a]
19	114-50	-	-	Unassignable; exterior exfoliated
20	117-71	le	1 or 2	No interior rim decoration
21	117-103	Ib/IIIb	3	Circular punctates present
17	117-124	Xa	6	Circular punctates present; brushed
22	118-118	Ib/IIb, c/IIIb	3	Pseudo cord cordwrapped object impressions
23	118-53	IX	4	
24	122-23	If	1	Twisted cord cordwrapped object impressions, symmetrical lip; vertical lip motif
25	122-33	Ip	3	Circular, superimposed punctates

[a] Attributes listed in the Comments column are those that are not consistent with the definition of the clusters, as outlined in Table 23.

TABLE 25

COMPARISON OF STOTT AND SMITH SITES BLACKDUCK TYPES - AREA F

VESSEL NUMBER	CATALOGUE NUMBER	STOTT MODE	SMITH CLUSTER	COMMENTS[a]
28	99-43	III	3	Symmetrical lip
29	99-84	?	?	Dentate stamp and boss; would be Cluster 2 if cordwrapped object used rather than dentate stamp
30	99-344	VI	3	Beveled-out lip; pseudo cord cordwrapped object impression
31	100-485	Vc	2	Twisted cord cordwrapped object impression; no interior rim decoration
32	100-42	X	6	
33	100-114	I/II/III/IV	3?	Interior exfoliated
34	100-17	IIIc	1	Twisted cord cordwrapped object impression; no banded motif; punctates not superimposed
35	100-322	Ii/II	1 or 2	No interior rim decoration; cross-hatched lip motif
36	101-281	I/II/III/IV	4?	Exterior row of cordwrapped paddle edge oblique impressions
37	101-293	I/II III/IV	1	Twisted cord cordwrapped object impressions; lip incised vertically
38	101-12	?	?	Dentate stamp and boss; doesn't fit
39	101-122	IX	4	
40	101-173	IdIf/IIIa	1 or 2	Twisted cord cordwrapped object impression; symmetrical lip
41	101-212	?	?	Dentate stamp and boss; would be Cluster 2 if cordwrapped object used rather than dentate stamp
42	101-213	VIc	1	Twisted cord cordwrapped object impressions
43	125-29	I	1	No interior rim decoration

TABLE 25, Continued

VESSEL NUMBER	CATALOGUE NUMBER	STOTT MODE	SMITH CLUSTER	COMMENTS
44	125-30	IIIb	3	Beveled-out lip; exterior row of cordwrapped paddle edge impressions
45	125-31	I/II	2	Twisted cord cordwrapped object impressions; interior rim exfoliated
46	102-19	?	?	Incised; doesn't fit
47	102-145	Ia	1 or 2	Chevron motif on lip

[a] Attributes listed in the Comments column are those that are not consistent with the definition of the clusters, as outlined in Table 23.

TABLE 26

HORIZONTAL DISTRIBUTION OF BLACKDUCK CLUSTER VESSELS

AREA	UNITS	NUMBER VESSELS	CLUSTERS
Upper B	117, 118	5	1 or 2, 3, 4, 6
	122	2	1, 3
F	99, 100, 101	15	1, 2, 3, 4, 6, Unclassified
	102	2	1 or 2, Unclassified
	125	3	1, 2, 3

At this point, one might indeed question the validity of Smith Site data for analysis of Stott Site Blackduck materials. To summarize a comparison of the ceramics from the two sites:

1) Ceramic materials from both the Smith and Stott Sites are universally regarded as Blackduck.

2) Radiocarbon dates from both sites are comparable, indicating two peaks of occupation. At the Stott Site, these centre upon an A.D. 800 - 900 and A.D. 1100 - 1200 time frame.

3) Smith Site ceramic materials have been isolated stratigraphically into Early and Late Blackduck groups, each containing chronologically significant attributes.

4) Stott Site Blackduck ceramics also display these significant attributes, but the lack of a reliable internal stratigraphy makes it impossible to use them to locate Early and Late Blackduck portions of the site, either horizontally or vertically.

5) More importantly, Stott Site Blackduck vessels do not fit precisely within the six clusters of dependent attributes that Lugenbeal found valid for Smith Site Blackduck materials. Furthermore, Stott vessels are distributed horizontally throughout the site in an apparent haphazard fashion, with no separation of "early" cluster vessels (1 and 2) from "late" cluster vessels (3 - 6).

This "stalemate" situation is, in fact, not unexpected, if one recalls the variability in Blackduck ceramics established for the Stott, Wanipigow and Aschkibokahn Sites in Manitoba. Certainly no one would propose that Smith and Stott Site Blackduck ceramics were fashioned by the same potters, just because they represent basically the same time periods. Geographical distance does seem to be positively correlated with stylistic differences in this instance. It is truly unfortunate, however, that the nature of the recoveries at DlMa-1 are such that it is virtually impossible to delineate stratigraphically reliable sections of the site for comparative purposes.

One task remains to complete the description of ceramics recovered from DlMa-1 in 1982, that of discussing vessels which do not fit easily into either the established Stott modes or the Smith Site clusters. In Area F, four such vessels were recovered in 1982 (Figure 54). Three of these -- Vessel 29 (99-84), Vessel 38 (101-12) and Vessel 41 (101-212) -- are decorated with dentate stamps and bosses, while the fourth, Vessel 46 (102-19), is incised. The decorative motif is basically the same for these four vessels, oblique over horizontal on the rims and oblique on the lips. This motif incorporates easily into the standard Blackduck ceramic motif, yet the decorative elements are unusual.

In Manitoba, dentate stamps and bosses are generally associated with Laurel ceramics, a Middle or Initial Woodland manifestation predating Blackduck, while incising is a trait indicative of Plains influence. The three dentate stamped and bossed vessels occurred at variable depths within the "trench" of adjacent units at the back of the terrace. Vessels 29 and 38 were found in Units 99 and 101 at depths of 13 and 9 cm below surface, respectively; both were well above the bone bed. Vessel 41, however, also located in Unit 101, was contained within the bone bed at a depth of 35 cm below surface in conjunction with other, traditional Blackduck vessels. The incised vessel, 46, was retrieved at a depth of 5 cm below surface from Unit 102, which also contained the two vertical bone features.

Figure 54. Unclassified vessels from Area F.

(a) Vessel 29, 99-84.
(b) Vessel 38, 101-12
(c) Vessel 41, 101-212
(d) Vessel 46, 102-19.

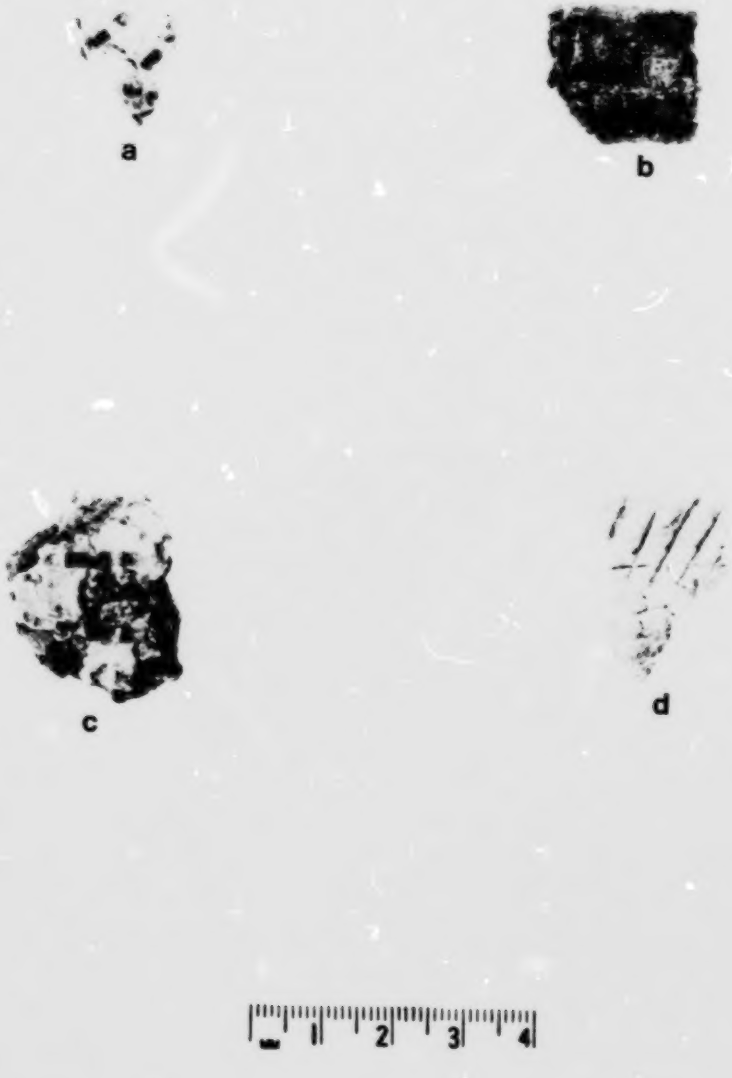


Figure 54. Unclassified vessels from Area F.

If one looks at ceramic materials from the 1979 excavations in Area F, additional vessels which seem unusual may be identified. At the close of the 1979 Field School, Leigh Syms summarized the ceramic recoveries:

> Despite the fact that the analysis of the materials has not yet taken place, a number of important preliminary observations can be made. First, the materials are Blackduck.
>
> However, there are some interesting variations. There are rim sherds from at least 5 vessels in which the decorative motif is applied by incising rather than cord-wrapped stick. The incising technique is a Plains trait rather than a Boreal Forest trait and is not normally found on Blackduck pottery nor at the Stott Site; it has been found only in the Park and Tisdale (1978) found only 1 example (1.69% of the sample of vessels). In Zone F, it is an important, if not dominant, trait.
>
> The localized distribution of such traits and the variability across the site is important for constructing models of social organization. For example, Zone F may be a localized social group, such as extended family, with a relatively high percentage of one Plains trait in the ceramics.
>
> Two sherds with dentate stamping also occurred. One was highly unusual with paired bands above and below a punctate. These were found with the Blackduck materials and there is no indication that they represent some earlier Middle Woodland population; since early Blackduck and Late Laurel overlap by at least 300-400 years (Syms 1977), this association is not unexpected (Syms et al. 1979:132-133).

Because personal observation of the 1979 Field School vessels was not possible, notes and photographs were utilized for information about them (see Figure 8 for location of the Field School units). Unit 60 contained remnants of two individual incised vessels (60-2-5, 60-3-44; 60-4-32), as well as a rimsherd (60-3-125) decorated with dentate stamps and a triangular punctate (Syms et al. 1979:60; 63-64). In addition, this unit also contained a vertical bone feature similar to the two discovered in Unit 102 in 1982. Test Pit 5 and Unit 58 each held rimsherds (F5-3-14; 58-3-7) decorated with incised lines (Syms et al. 1979:104). In Unit 101 in 1982, Vessel 37 (101-293) also had a lip that was decorated with incised lines, rather than the customary cordwrapped object impressions. Finally, in Test Pit 4, a large rimsherd was recovered (F4-5-52); it displayed a Mode II decorative motif, but the design was executed with incised lines rather than cordwrapped object impressions (Syms et al. 1979:42).

Ceramics excavated in Area F by the BAAR Project in 1979 have been available for inspection and this group also contains vessels which do not readily fit into a Blackduck typology. Unfortunately the report of the 1979 ceramic recoveries (Hamilton 1981) does not detail which of the rimsherds and reconstructions comprised the 27 vessels used for modal analysis, nor which modes were assigned to which vessels. Therefore, it is possible that some of the rims discussed here are not dealt with in the BAAR report.

Undoubtedly the peculiar dentate stamped vessel Syms referred to in the previous quotation (Syms et al. 1979:132) is that recovered from Unit 69. (See Figure 8 for the location of the BAAR Project units.) The exterior rim of this specimen (69-3-43) is decorated with two rows of dentate stamps running parallel to the lip; these are intersected by two parallel rows of dentate stamps running perpendicular to the lip. A single boss is located at the junction of the two bands (Figure 55a). Neither lip nor interior are decorated on this vessel. Another vessel exhibiting a boss (68-8-133) was recovered in adjacent Unit 68. In general it resembled the former bossed vessel, but rather than dentate stamps, the lip and upper rim were cordwrapped object impressed (Figure 55b). This vessel would probably be placed within Lugenbeal's Cluster 2, although it lacks a smooth exterior, interior decoration and pseudo cordwrapped object impressions. Incidentally, Unit 68 also contained a vertical bone feature similar to the others previously mentioned.

Figure 55. BAAR Project unclassified vessels from Area F.

(a) 69-3-43
(b) 68-8-133
(c) 75-9-179
(d) 78-7-97

Figure 55. BAAR Project unclassified vessels from Area F.

Hamilton mentions recovery of six incised vessels from Area F in 1979 (1981:163), but when the ceramics involved were examined, only two incised vessels were found. Perhaps his total of six vessels also includes those recovered in Area F by the Field School in 1979. The first vessel, catalogued as 75-9-179 and recovered from Unit 75 (see Figure 55c; also Hamilton 1981:Plate Vb), has been classified by Hamilton within the modal typology as Mode In (a new variant). This author would dispute that classification on grounds that the area of the rim considered to be a punctate is in fact a heat spall from the surface of the vessel, which also contains other smaller spalls. Within the modal system this vessel would more appropriately be considered Mode II, but nonetheless, its vertical/horizontal exterior rim motif is executed with incised lines rather than cordwrapped object impressions. This rim is also thinner than most Blackduck vessels, with the lip measuring only 2 mm larger than lower portions of the rim. The second vessel was retrieved from Unit 78. It is represented by bodysherd 78-7-97, which bears a smoothed surface decorated with two parallel, broadly incised lines (Figure 55d). The curvature of this sherd indicates a vessel much smaller than most other Blackduck vessels found at the Stott Site.

In addition to these four vessels, three other unlikely Blackduck candidates were recovered by the BAAR Project. From Unit 79 vessel 79-5-57 (Figure 56a) is fabric impressed and bossed, as well as notch lipped (see also Hamilton 1981:Plate VIIIb). The lip and rim are thinned in comparison with the body and this vessel's overall appearance is not that of Blackduck. Another small notched rim, (76-2-48), was recovered from Unit 76, but the size of the sherd precludes discussion other than noting its presence (Figure 56b). The final vessel (75-7-124; 75-9-62; 75-10-161) is also fabric-impressed and undecorated except for a single row of small circular punctates below the lip (Figure 56c). It, like vessel 79-5-57, would be considered Mode X in Tisdale's typology, but Tisdale herself doubts the authenticity of these vessels as Blackduck. "Mode X is represented quite well numerically, however, since it appears to occur only at the Stott Site, its status as a Blackduck ceramic mode remains somewhat suspect" (Pokotylo and Tisdale 1982).

When attention is shifted to the park portion of the site, atypical vessels are also found in each of the three excavation areas. (See Figure 2 for the location of these areas.) Area A produced two vessels which, although they fit within the Blackduck modal system, are somewhat unusual. Vessel 1, portions of which were recovered from Units 17 in 1977 and 80 in 1981, is decorated with cordwrapped object impressions and bosses (Figure 57c; see also Tisdale 1978:Plate 2). It fits within Lugenbeal's Cluster 2, except that the cord impressions are not "pseudo" cord impressions. Vessel 4 was retrieved from Units 17 in 1977 and 85 in 1981. Incised lines are utilized for interior, exterior and lip obliques; as well, two horizontal bands of incised lines encircle the upper rim. A series of linear punctates is superimposed over the exterior rim oblique incisions and the vessel is fabric impressed (Figure 57b; Tisdale 1978:Plate 2). Although the motif of this vessel marks it as Mode I, the combination of prolific use of incisions and fabric impressions make it unusual.

In Area Upper B, two vessels have been identified by Tisdale as out of the ordinary. Vessel 1 is a pipe fragment, but this particular type of variation is not of concern for the present analysis. Vessel 2, however, is of interest. Recovered from Unit 86 in 1981 (see Figure 9 for location of

Figure 56. BAAR unclassified vessels from Area F.

(a) 79-5-57
(b) 76-2-48
(c) 75-9-62 & 75-10-161

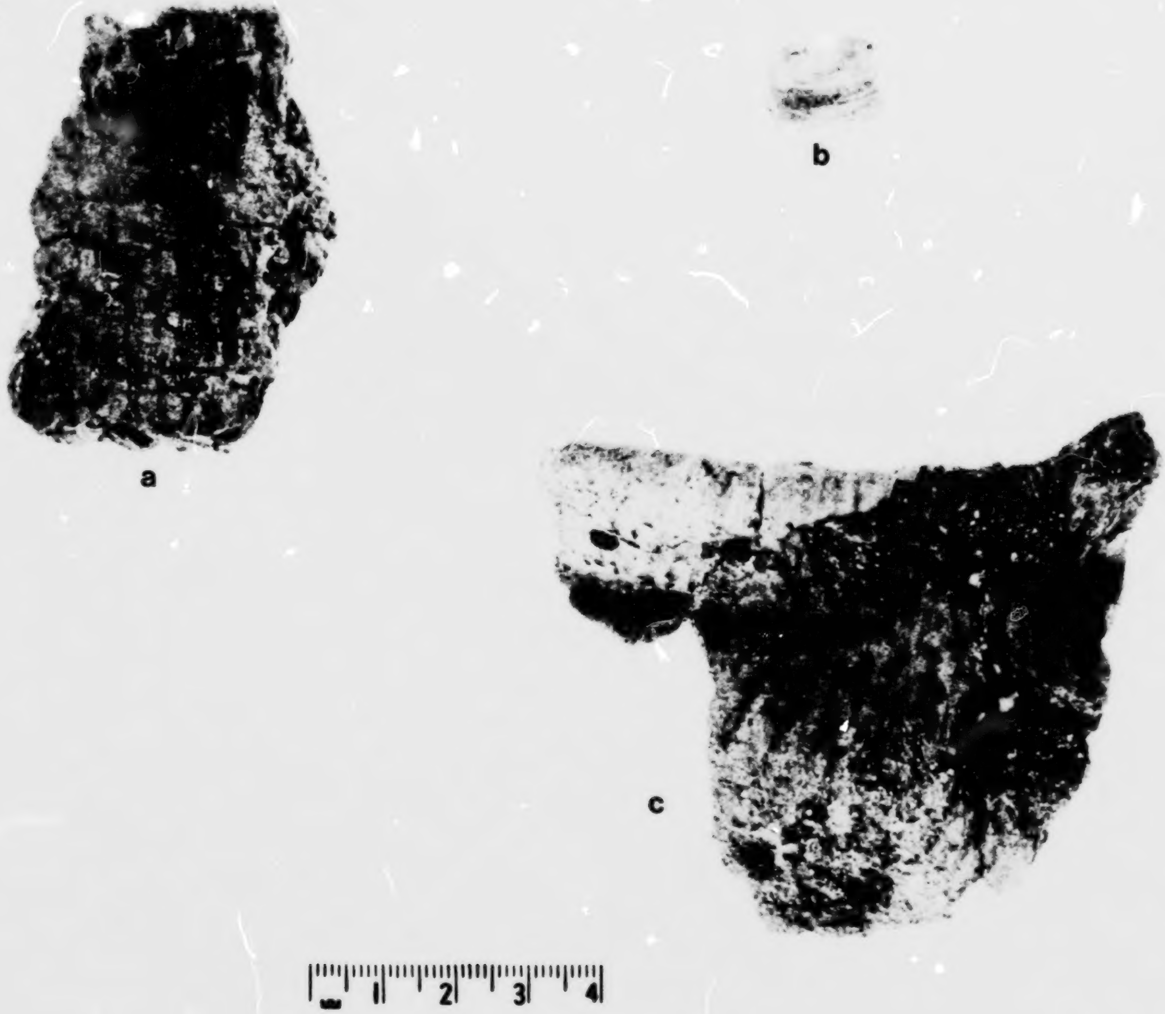


Figure 56. BAAR Project unclassified vessels from Area F.

Figure 57. Unclassified vessels from Areas A and Upper B.

(a) Area Upper B, Vessel 2, 86-01-326
(b) Area A, Vessel 4,17-2-15
(c) Area A, Vessel 1, 17-5-5

Figure 57. Unclassified vessels from Areas A and Upper B.

Unit 86), it is an upper rim/neck segment of a very small incised pot (Figure 57a). It has no affinity with Blackduck other than the motif of oblique (one row of incisions) over horizontal (four rows of incisions).

It is in Area Lower B, however, that the greatest number of unusual vessels occur (8 out of 17 identified). As in Area F, Lower B contains a high percentage of bossed and dentate stamped vessels (Figure 58). Vessels 2 (Unit 55) and 6 (Unit 53) are both dentate stamped and bossed, while Vessels 4 (Unit 95) and 5 (Unit 98) are just dentate stamped. Vessel 7 (Unit 94) combines an incised lip and rim with interior oblique dentate stamps. Bosses also occur in conjunction with cordwrapped object impressions on Vessels 9 (Unit 96), 10 (Unit 94) and 14 (Unit 98). These latter three fit within the Mode II category or Lugenbeal's Cluster 2 of cord impressed/bossed vessels, which at the Smith Site were an "early" Blackduck manifestation. These vessels could be considered somewhat aggregated in Lower B, considering their scarcity in other areas of the park. In one instance, a cordwrapped object impressed and bossed vessel was found associated with a dentate stamped vessel (Vessels 5 and 14: Unit 98).

The preceding exercise in comparative ceramic typology with materials from DlMa-1 can be considered dubious at best, if for no other reason than that the sample size is small and certainly not representative of either the numbers nor the kinds of vessels already identified for the Stott Site from previous excavations. At this point, an intensive study of all the vessels from the Stott Site would certainly be appropriate. Such an analysis would at least standardize the individual and idiosyncratic biases that have inevitably found their way into this and other reports.

Despite the usual constraints of time and sample size which affect reports such as this one, some tentative conclusions may be drawn about the ceramic recoveries from the Stott Site (Table 27). As previously stated, the Stott Site is overwhelmingly Blackduck; 69% of all ceramics recovered within Grand Valley Provincial Recreation Park and 67% of the recoveries from Area F can be readily assigned to Blackduck modes (Blackduck and Mode II groups in Table 27). If Mode X vessels are also considered to be Blackduck, these figures rise to 72% and 78% respectively. However, there are significant amounts of atypical vessels present at the site which indicate occupations by cultural groups other than Blackduck.

1) In Area Lower B, six of the 17 vessels (35%) are either dentate stamped or dentate stamped and bossed; in Area F, these vessels make up 8% of the total.

2) Mode II vessels (cordwrapped object impressed/bossed), which fit Lugenbeal's definition of Early Blackduck, are virtually absent in Area F (one vessel), but comprise six of 39 vessels (15%) in the park. Five of these six vessels occur in Area Lower B in association with the dentate stamped and dentate stamped and bossed vessels.

3) In Grand Valley Provincial Recreation Park, only one incised vessel was recovered, but in Area F eight of the 60 vessels (13%) were incised.

4) Mode X vessels also form a negligible amount of the park ceramic recoveries, but constitute seven of the 60 vessels (12%) retrieved from Area F.

Despite the difficulty experienced in vertically separating Early and Late Blackduck occupations, it does seem possible to suggest on the basis of

Figure 58. Unclassified vessels from Area Lower B.

(a) Vessel 2, 55-7-2
(b) Vessel 6, 53-4-8
(c) Vessel 4, 95-B5-219
(d) Vessel 5, 98-B4-189
(e) Vessel 9, 96-B8-568
(f) Vessel 10, 94-B3-83
(g) Vessel 14, 98-B8-474

a
b
c
d
e
f
g
1
2
3
4

Figure 58. Unclassified vessels from Area Lower B.

horizontal stratigraphy, however tentatively, that there were occupations of non-Blackduck ceramic-using peoples utilizing Area F (incised and Mode X vessels) and Area Lower B (dentate stamped and dentate stamped/bossed vessels). Some possible identities of these other groups will be discussed in Chapter V.

TABLE 27

DISTRIBUTION OF CERAMIC GROUPS AT DlMa-1

	Grand Valley Provincial Recreation Park			Stott Farm			
	AREA A	UPPER B	LOWER B	FIELD SCHOOL	BAAR	1982	TOTAL
Blackduck[a] (Modes I, III-IX)	2	15	4	7	17[c]	15	60
Mode II (CWOI/ Bossed)	1	0	5	0	1	0	7
Dentate Stamped	0	0	4	1	1	0	6
Dentate/Bossed	0	0	2	0	0	3	5
Incised	1	1	1	5	2	1	11
Mode X	0	1	0	0	6	1	8
Pipe	0	1	1	0	0	0	2
TOTAL VESSELS	4	18	17	13[b]	27	20	99

[a] All Blackduck modes, excepting II and X are included in this category, as well as previously unclassified vessels, which are nevertheless considered Blackduck because they are cordwrapped object impressed.

[b] This total is a minimum figure tallied from Syms et al. 1979. Because all excavated units and test pits were not analyzed, the final total will be in excess of 13 vessels.

[c] Because no details were available regarding mode assignment to specific vessels the figure of 17 Blackduck vessels is obtained by subtracting the author's visual assessment of the vessels which belonged to the other groups from the total number of vessels as reported by Hamilton (1981).

LITHICS

As expected from the experiences of previous excavators at DlMa-1, lithic tools and debitage comprised the largest group of items recovered (excepting bone, of course) in 1982. In anticipation of the large number of artifacts to be handled prior to actual analysis, special effort was made to clean and catalogue as much material as possible while still in the field. Cleaning and cataloguing processes were carried out by the crew on a regular basis, therefore, as well as during periods of inclement weather. A laboratory structure was erected on the site (Figure 59) and the laboratory supervisor devoted most of her work time to the planning and design of an artifact coding format, as well as the actual coding of the initial lithic recoveries from Units 99, 100 and 101 in Area F.

Many difficulties were experienced. If ever an archaeological site needed computer-assisted analysis, it is the Stott Site with its thousands and thousands of bones, lithic tools and potsherds. Certainly efforts expended by the 1981 crew in this direction are admirable; lithic and faunal recoveries have been computer coded and analyzed for the report on that year's excavations (Pokotylo and Tisdale 1982). The 1981 lithic coding format was not transferable to the 1982 recoveries, however, both because excavation procedures differed between the two years and because fiscal constraints would not permit so extensive a lithic analysis. Classification of lithic raw materials also presented a problem. As no site specific reference collection of lithic raw materials existed for DlMa-1, one was created utilizing artifacts from the site for examples, as much as possible. This collection has been kept intact for future use by other analysts.

The major difficulty encountered with the 1982 lithic analysis, however, proved to be lack of time. Although artifact class and raw material

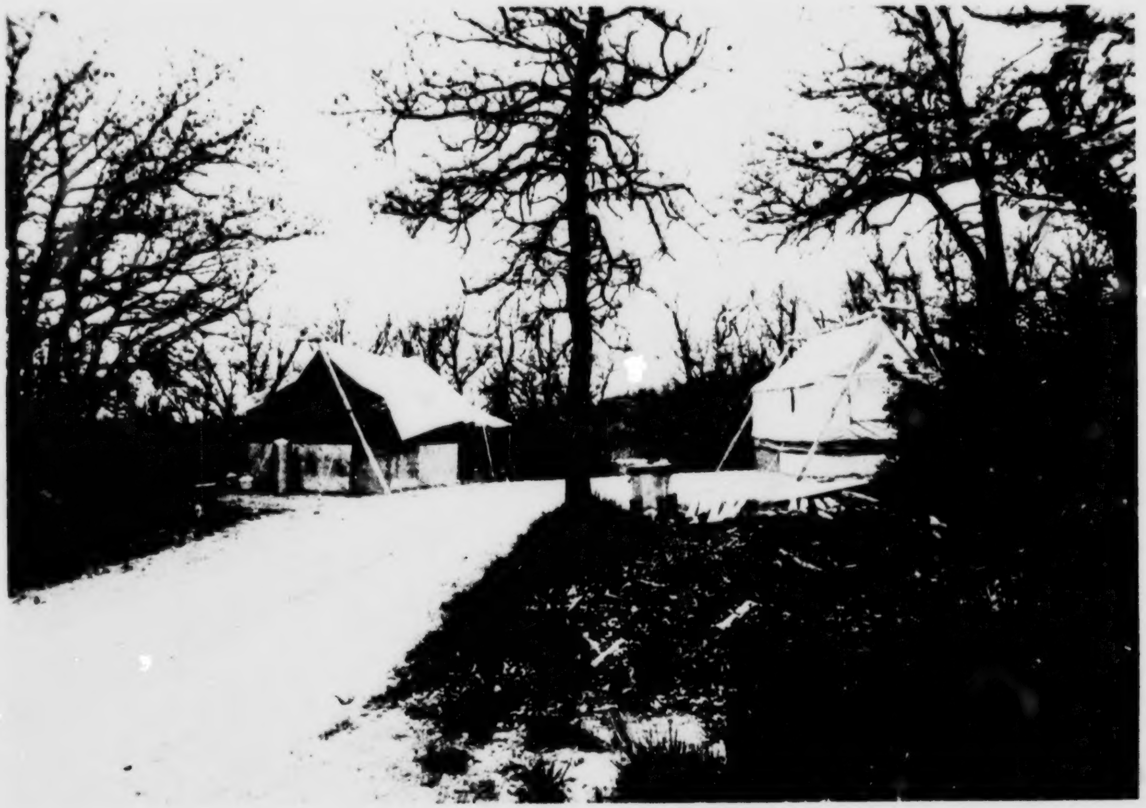


Figure 59. Kitchen and laboratory tents.

identifications, as well as the coding of these items for computer analysis (see Appendix IV for the lithic coding format) and the runs themselves, were accomplished by the laboratory supervisor, there was not enough time remaining to actually write the report. In large part, then, the following section on the 1982 lithic recoveries from the Stott Site has been written by the senior author from materials provided by the laboratory supervisor. Responsibility for any interpretations made from these materials belongs, of course, to the senior author.

A total of 2335 lithic items were recovered from DlMa-1 in 1982. Similar to the distribution of ceramic potsherds, most lithic materials were retrieved from the farm portion of the site -- 2059 items from Area F, but only 276 from Area Upper B. The distribution of lithic materials is even more highly concentrated in Area F than the pottery, however. Table 28 compares the distributions of these major types of recoveries.

TABLE 28

CERAMIC AND LITHIC RECOVERIES IN 1982

	NUMBER SHERDS	PERCENTAGE SHERDS	NUMBER LITHICS	PERCENTAGE LITHICS
Area Upper B	208	25.5	276	11.8
Area F	606	74.5	2059	88.2

Not unexpectedly, the major portion of the lithic recoveries consisted of the by-products of tool manufacture or refurbishing. A shortage of time prohibited all but the most simple analysis of this debitage. Table 29 details the distribution of nonartifactual lithic materials by unit per area, while Figures 60 and 61 display this data graphically.

TABLE 29

1982 LITHIC DEBITAGE

AREA UPPER B				AREA F			
UNIT	CO-ORDINATES	DEBITAGE[a]		UNIT	CO-ORDINATES	DEBITAGE	
		#	%			#	%
105	54N 24W	1	0.4	99	0N 104E	500	27.1
106	53N 24W	0	0.0	100[e]	0N 105E	559	30.3
107	52N 24W	0	0.0	101[f]	0N 106E	301	16.3
108	52N 25W	2	0.8				
109	53N 25W	1	0.4	102[g]	1S 125E	132	7.2
110	54N 25W	0	0.0	103	0N 125E	19	1.0
				104	2S 125E	60	3.3
111	9S 40W	16	6.5				
112	8S 40W	45	18.4	125	8S 93E	276	14.9
113	7S 40W	60	24.5			1847	100.1
114	6S 40W	22	9.0				
115	5S 40W	2	0.8				
116	4S 40W	8	3.3				
117	15S 47W	14	5.7				
118[b]	15S 46W	50	20.4				
119	46S 25W	3	1.2				
120[c]	46S 26W	4	1.6				
121	46S 27W	9	3.7				
122[d]	47S 25W	6	2.5				
123	47S 26W	1	0.4				
124	47S 27W	1	0.4				
		245	100.0				

[a] Cores not included as debitage, but rather as a separate artifact class.
[b] Includes material in balk between 117 and 118.
[c] Includes material in balk between 120 and 121.
[d] Includes material in balk between 122 and 119.
[e] Includes material in balk between 99 and 100.
[f] Includes material in balk between 100 and 101.
[g] Includes material from Features 1 and 2.

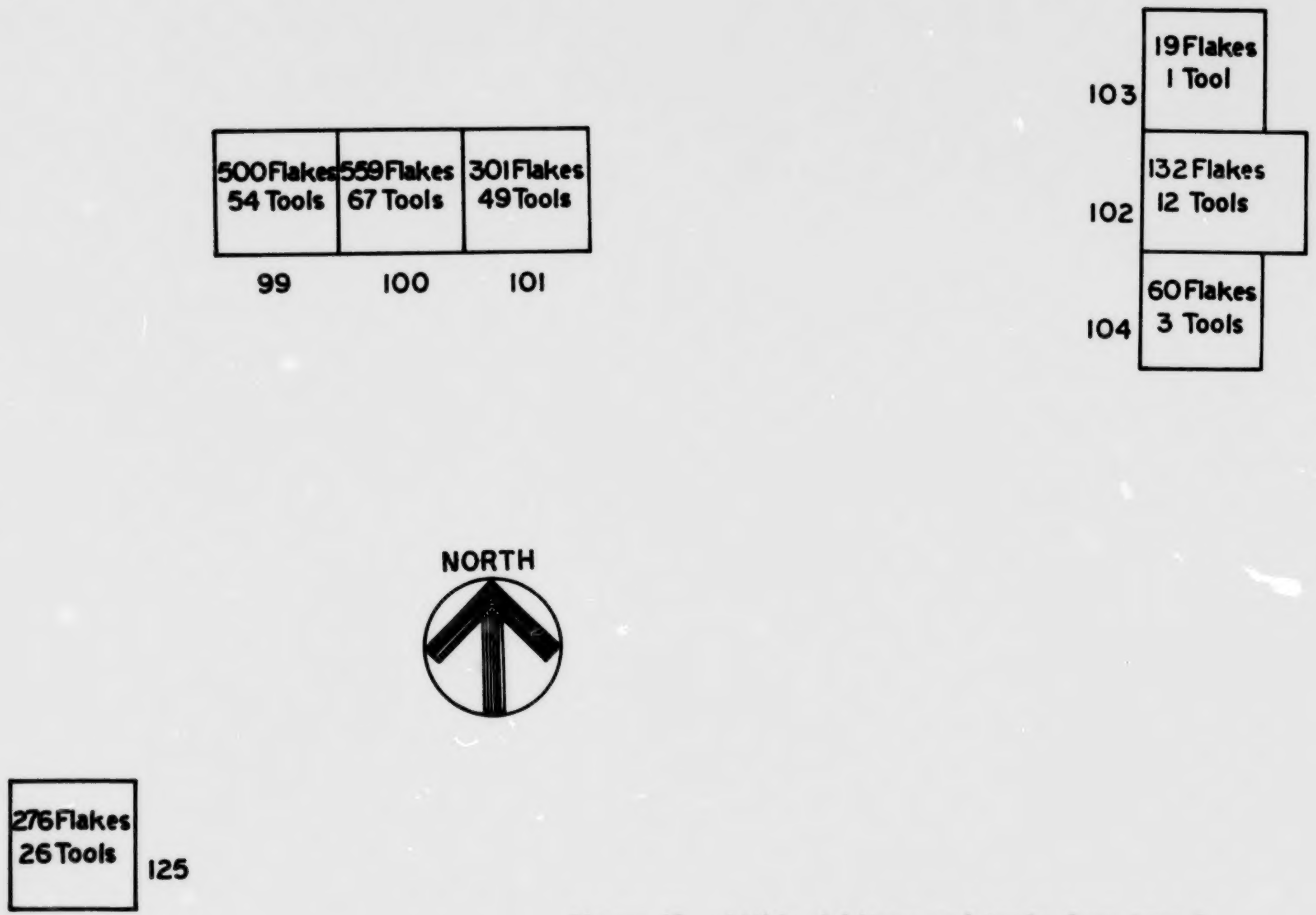
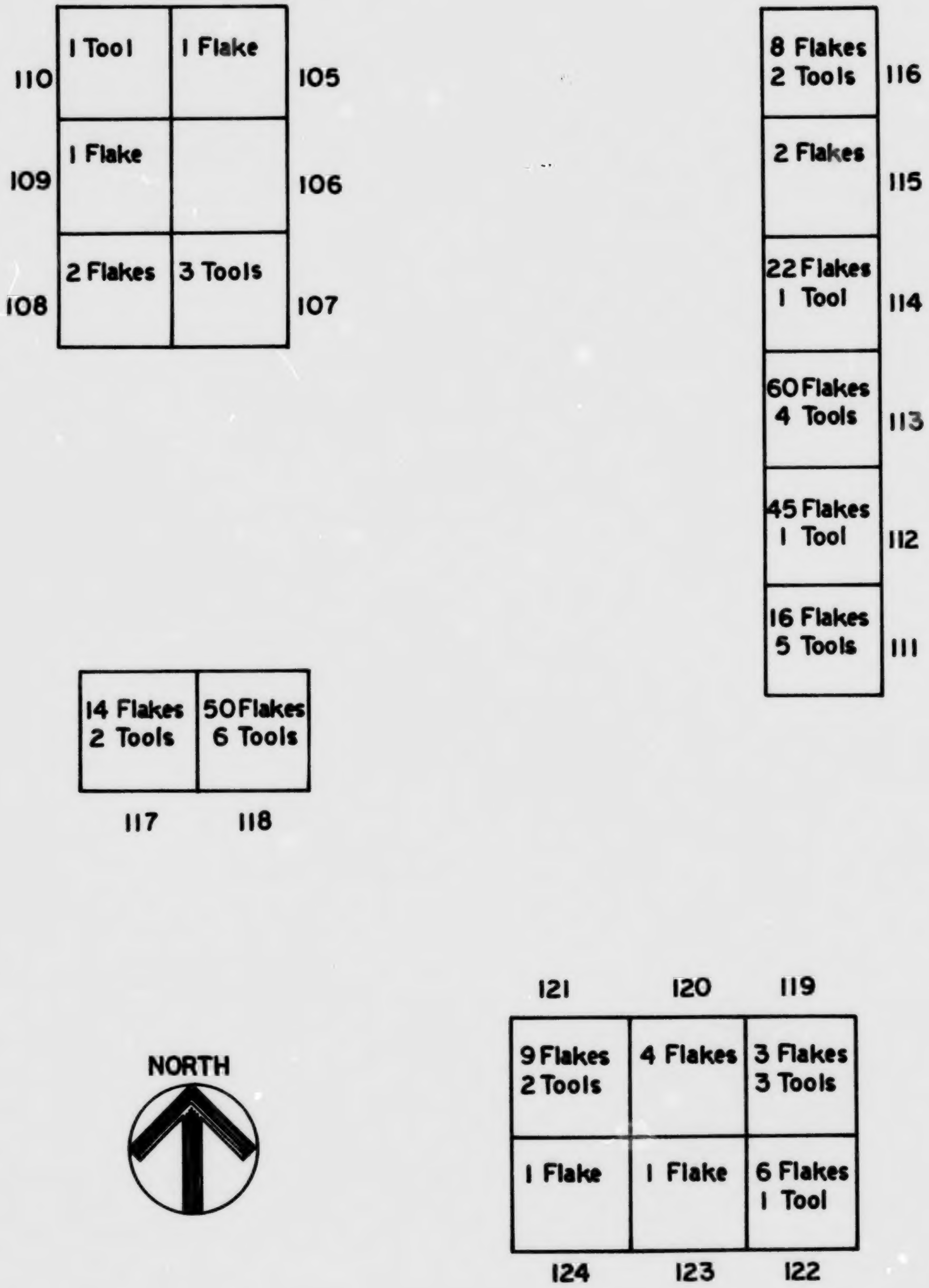

19 Flakes
1 Tool
103
132 Flakes
12 Tools
102
60 Flakes
3 Tools
104
500 Flakes
54 Tools
99
559 Flakes
67 Tools
100
301 Flakes
49 Tools
101
NORTH
276 Flakes
26 Tools
125

Figure 60. Lithic debitage and tools from Area F.



I Tool
I Flake
110
105
I Flake
109
106
2 Flakes
3 Tools
108
107
8 Flakes
2 Tools
116
2 Flakes
115
22 Flakes
I Tool
114
60 Flakes
4 Tools
113
45 Flakes
I Tool
112
16 Flakes
5 Tools
111
14 Flakes
2 Tools
50 Flakes
6 Tools
117
118
121
120
119
NORTH
9 Flakes
2 Tools
4 Flakes
3 Flakes
3 Tools
I Flake
I Flake
6 Flakes
I Tool
124
123
122

Figure 61. Lithic debitage and tools from Area Upper B.

Among the lithic items classified as artifacts for analysis, some 14 individual classes were defined as follows:

Cores and Core Fragments: lithic items from which at least four or more flakes have been removed.

Primary Implements:

Rough Unifaces - lithic items on which marginal retouch is limited to a few flakes deliberately removed from one surface.

Rough Uniface Fragments - portions of the above.

Rough Bifaces - lithic items on which marginal retouch is exhibited by a few flakes deliberately removed from both surfaces.

Rough Biface Fragments - portions of the above.

Utilized Unmodified Flakes - lithic items with a minimum of one edge exhibiting wear (flake scars, polish, striations, etc.)

Utilized Unmodified Blade/Linear Flake - lithic items with a "long narrow, parallel-sided outline and a triangular or prismatic cross-section" (Pokotylo in Pokotylo and Tisdale 1982) exhibiting signs of utilization as above.

Secondary Implements:

Fine Unifaces - lithic items which "exhibit well-defined outlines which are considered to reflect intentional shaping of the artifact. Extensive facial retouch, ... is located on one flake surface only" (Pokotylo in Pokotylo and Tisdale 1982).

Fine Uniface Fragments - portions of the above.

Fine Bifaces - "bifacially flaked artifacts with either pointed or rounded ends and acute edge-angles. There is no evidence of modification for the hafting of the implement" (Pokotylo in Pokotylo and Tisdale 1982).

Fine Biface Fragments - portions of the above.

Projectile Points - "bifacially flaked, symmetrical artifacts with a sharply pointed end, acute angled blade margins, and a basal modification to facilitate hafting. Such a morphological class is usually assumed to have functioned as arrow points" (Pokotylo in Pokotylo and Tisdale 1982).

An examination of the distribution of lithic tools within the various artifact classes for the two excavation areas (Table 30) reveals that, for most classes, recoveries run four to five times greater in Area F than Upper B. Only in the class of Fine Bifaces is the distribution equal at one biface for each excavation area.

Within the two major excavation areas (Upper B and F), differential distribution of lithic artifacts can readily be observed. In Area Upper B (Figure 61), 90% of the debitage and 78% of the tools are located within the eight units, 111 - 118, which range from 3S - 9S 40W and 15S 46W - 48W. Table 31 lists the distribution of the lithic tools from Area Upper B. In Area F (Figure 60), the original three contiguous units, 99, 100 and 101, contained 80.2% of all the lithic tools recovered from the farm portion of the site in 1982. These three units averaged 56.7 tools per m^3 while Unit 125 only produced 26 tools per m^3. Table 32 lists the distribution of lithic tools by artifact class for each unit in Area F.

Cores, core fragments and utilized blades were not analyzed further, but lithic tools contained within the remaining 11 artifact classes were subjected to closer scrutiny. The five artifact classes consisting of fragments were combined with the appropriate classes of whole specimens. Then the resulting six classes of tools, Rough Unifaces, Rough Bifaces, Utilized

TABLE 30

DISTRIBUTION OF LITHIC ARTIFACT CLASSES BY AREA

ARTIFACT CLASS	AREA UPPER B		AREA F		TOTAL	
	Number	Per Cent	Number	Per Cent	Number	% All Classes
Cores	5	15.6	27	84.4	32	13.2
Core Fragments	2	13.3	13	86.7	15	6.2
Rough Unifaces	6	21.4	22	78.6	28	11.5
Rough Uniface Fragments	0	0.0	9	100.0	9	3.7
Rough Bifaces	1	14.3	6	85.7	7	2.9
Rough Biface Fragments	1	6.7	14	93.3	15	6.2
Utilized Flakes	7	12.5	49	87.5	56	23.0
Utilized Blades	0	0.0	4	100.0	4	1.6
Fine Unifaces	1	7.7	12	92.3	13	5.3
Fine Uniface Fragments	1	16.7	5	83.3	6	2.5
Fine Bifaces	1	50.0	1	50.0	2	0.8
Fine Biface Fragments	1	16.7	5	83.3	6	2.5
Projectile Points	0	0.0	14	100.0	14	5.8
Projectile Point Fragments	5	13.9	31	86.1	36	14.8
	31		212		243	100.0

TABLE 31

DISTRIBUTION OF LITHIC TOOLS BY UNIT IN AREA UPPER B

UNIT	CO-ORDINATES	ARTIFACT CLASS	NUMBER OF TOOLS
107	52N 24W	Cores	1
		Rough Unifaces	1
		Utilized Flakes	1
110	54N 25W	Utilized Flakes	1
111	9S 40W	Core and Core Fragments	2
		Utilized Flakes	2
		Projectile Point Fragments	1
112	8S 40W	Rough Bifaces	1
113	7S 40W	Cores	2
		Rough Biface Fragments	1
		Fine Unifaces	1
114	6S 40W	Rough Unifaces	1
116	4S 40W	Cores	1
		Projectile Point Fragments	1
117	15S 47W	Projectile Point Fragments	2
118[a]	15S 46W	Core Fragments	1
		Rough Unifaces	2
		Utilized Flakes	2
		Projectile Point Fragments	1
119[b]	46S 25W	Rough Unifaces	2
		Rough Bifaces	1
121	46S 27W	Fine Uniface Fragments	1
		Fine Biface Fragments	1
122[c]	47S 25W	Utilized Flakes	1
			31

a Includes tools from the balk between 117 and 118.
b Includes tools from the balk between 119 and 120.
c Includes tools from the balk between 122 and 119.

TABLE 32

DISTRIBUTION OF LITHIC TOOLS BY UNIT IN AREA F

UNIT	CO-ORDINATES	ARTIFACT CLASS	NUMBER OF TOOLS
99	ON 104E	Cores	5
		Core Fragments	3
		Rough Unifaces	4
		Rough Uniface Fragments	4
		Rough Bifaces	1
		Rough Biface Fragments	3
		Utilized Flakes	9
		Utilized Blades	2
		Fine Unifaces	5
		Fine Uniface Fragments	2
		Fine Biface Fragments	1
		Projectile Points	7
		Projectile Point Fragments	8
100	ON 105E[a]	Cores	9
		Core Fragments	5
		Rough Unifaces	5
		Rough Uniface Fragments	3
		Rough Bifaces	1
		Rough Biface Fragments	5
		Utilized Flakes	16
		Utilized Blades	1
		Fine Unifaces	5
		Fine Biface Fragments	3
		Projectile Points	6
		Projectile Point Fragments	8
101	ON 106E[b]	Core Fragments	3
		Rough Unifaces	6
		Rough Uniface Fragments	1
		Rough Bifaces	4
		Rough Biface Fragments	2
		Utilized Flakes	15
		Utilized Blades	1
		Fine Unifaces	3
		Fine Uniface Fragments	1
		Fine Bifaces	1
		Projectile Points	3
		Projectile Point Fragments	9

UNIT	CO-ORDINATES	ARTIFACT CLASS	NUMBER OF TOOLS
102	1S 125E[c]	Cores	3
		Rough Unifaces	3
		Utilized Flakes	2
		Unifaces	1
		Biface Fragments	1
		Projectile Point Fragments	2
103	0N 125E	Projectile Point Fragments	1
104	2S 125E	Cores	1
		Rough Bifaces	1
		Utilized Flakes	1
125	8S 93E	Cores	6
		Core Fragments	5
		Rough Unifaces	3
		Rough Uniface Fragments	1
		Rough Bifaces	1
		Rough Biface Fragments	1
		Utilized Flakes	6
		Fine Uniface Fragments	1
		Fine Biface Fragments	1
		Projectile Point Fragments	1
			212

[a] Includes tools from the balk between 99 and 100.
[b] Includes tools from the balk between 100 and 101.
[c] Includes tools from Features 1 and 2.

Flakes, Fine Unifaces, Fine Bifaces and Projectile Points, were examined in some detail. Appendix V contains attributes and measurements for each artifact contained within these groups. Tables 33 - 38 provide summaries of the more important attributes, while Figures 62-69 illustrate many of the lithic artifacts recovered in 1982.

TABLE 33

METRIC ATTRIBUTES OF ROUGH UNIFACES

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	32	1.520 - 6.980	3.220	1.299	1.687
Width (cm)	32	1.100 - 4.400	2.037	0.800	0.640
Thickness (cm)	37	0.200 - 3.300	0.822	0.590	0.348
Weight (g)[a]	37	0.700 - 112.800	8.705	19.553	382.305

[a] Because weight measures combine whole and fragmentary specimens, data generated in this category may be unreliable or misleading.

TABLE 34

METRIC ATTRIBUTES OF ROUGH BIFACES

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	7	1.840 - 7.420	3.296	2.069	4.282
Width (cm)	17	1.160 - 5.800	2.367	1.116	1.246
Thickness (cm)	22	0.200 - 1.400	0.521	0.265	0.070
Weight (g)	22	0.300 - 65.900	4.909	13.732	188.567

TABLE 35

METRIC ATTRIBUTES OF UTILIZED FLAKES

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	55	1.100 - 4.600	2.398	0.784	0.615
Width (cm)	56	0.970 - 4.410	2.141	0.764	0.584
Thickness (cm)	56	0.140 - 1.380	0.548	0.293	0.086
Weight (g)	56	0.200 - 21.100	3.655	4.118	16.957

TABLE 36

METRIC ATTRIBUTES OF FINE UNIFACES

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	14	1.410 - 3.600	2.491	0.583	0.340
Width (cm)	16	1.160 - 3.150	1.637	0.494	0.244
Thickness (cm)	19	0.160 - 0.890	0.462	0.238	0.057
Weight (g)	19	0.100 - 6.000	2.142	1.867	3.485

TABLE 37

METRIC ATTRIBUTES OF FINE BIFACES

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	3	2.460 - 3.800	3.263	0.709	0.502
Width (cm)	6	1.080 - 5.050	2.253	1.447	2.093
Thickness (cm)	8	0.200 - 1.100	0.564	0.310	0.096
Weight (g)	8	0.300 - 43.900	7.600	14.828	219.857

TABLE 38

METRIC ATTRIBUTES OF PROJECTILE POINTS

	NUMBER	RANGE	MEAN	STANDARD DEVIATION	VARIANCE
Length (cm)	24	0.900 - 2.280	1.820	0.345	0.119
Width (cm)	45	0.960 - 2.000	1.373	0.233	0.054
Thickness (cm)	50	0.190 - 0.640	0.325	0.094	0.009
Weight (g)	50	0.200 - 3.000	0.798	0.520	0.270

Figure 62. Lithic tools from Area Upper B.

(a) Rough uniface, 107-24
(b) Fine uniface, 113-49
(c) Rough uniface, 119-12
(d) Rough uniface, 119-53
(e) Rough biface, 119-4

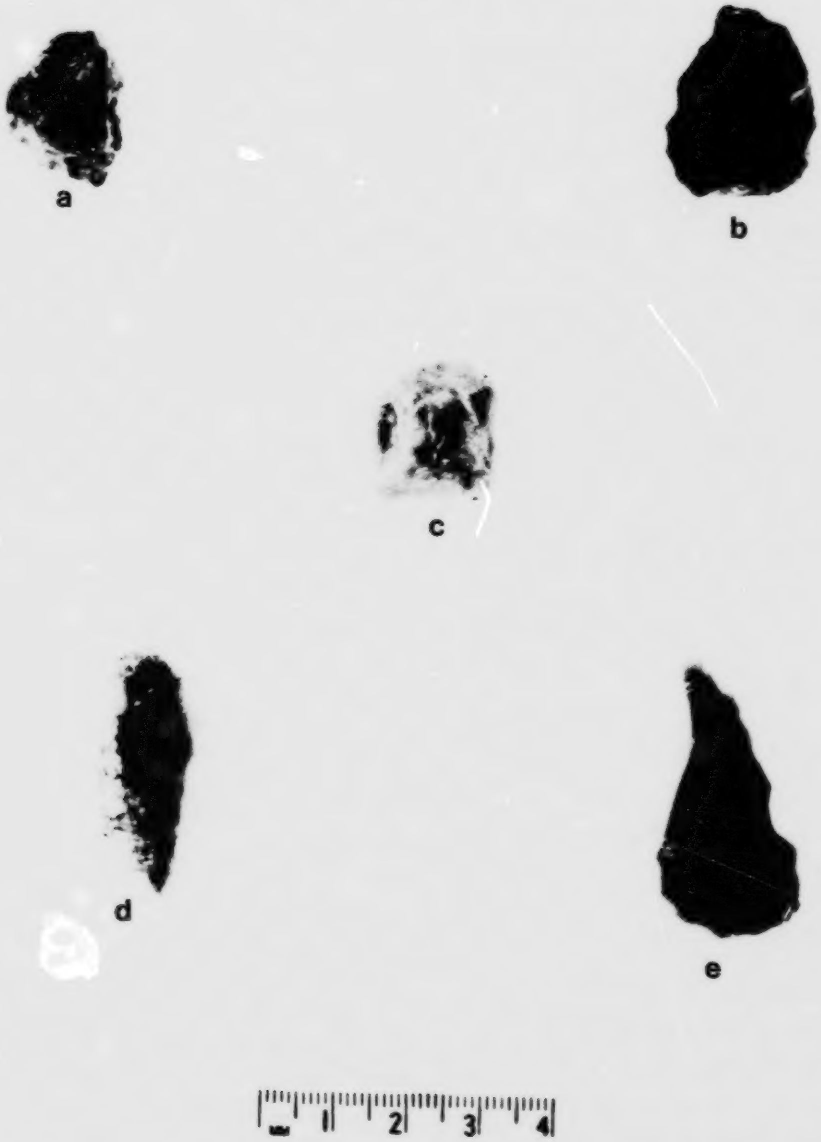


Figure 62. Lithic tools from Area Upper B.

Figure 63. Rough unifaces from Area F.

(a) 99-96
(b) 99-284
(c) 100-120-1
(d) 100-125
(e) 100-282-1
(f) 100-294-1
(g) 125-243
(h) 101-174-1

a
b
c
d
e
f
g
h
1
2
3
4

Figure 63 Rough unifaces from Area F.

Figure 64. Rough bifaces from Area F.

(a) 99-239
(b) 99-285
(c) 101-219
(d) 125-244

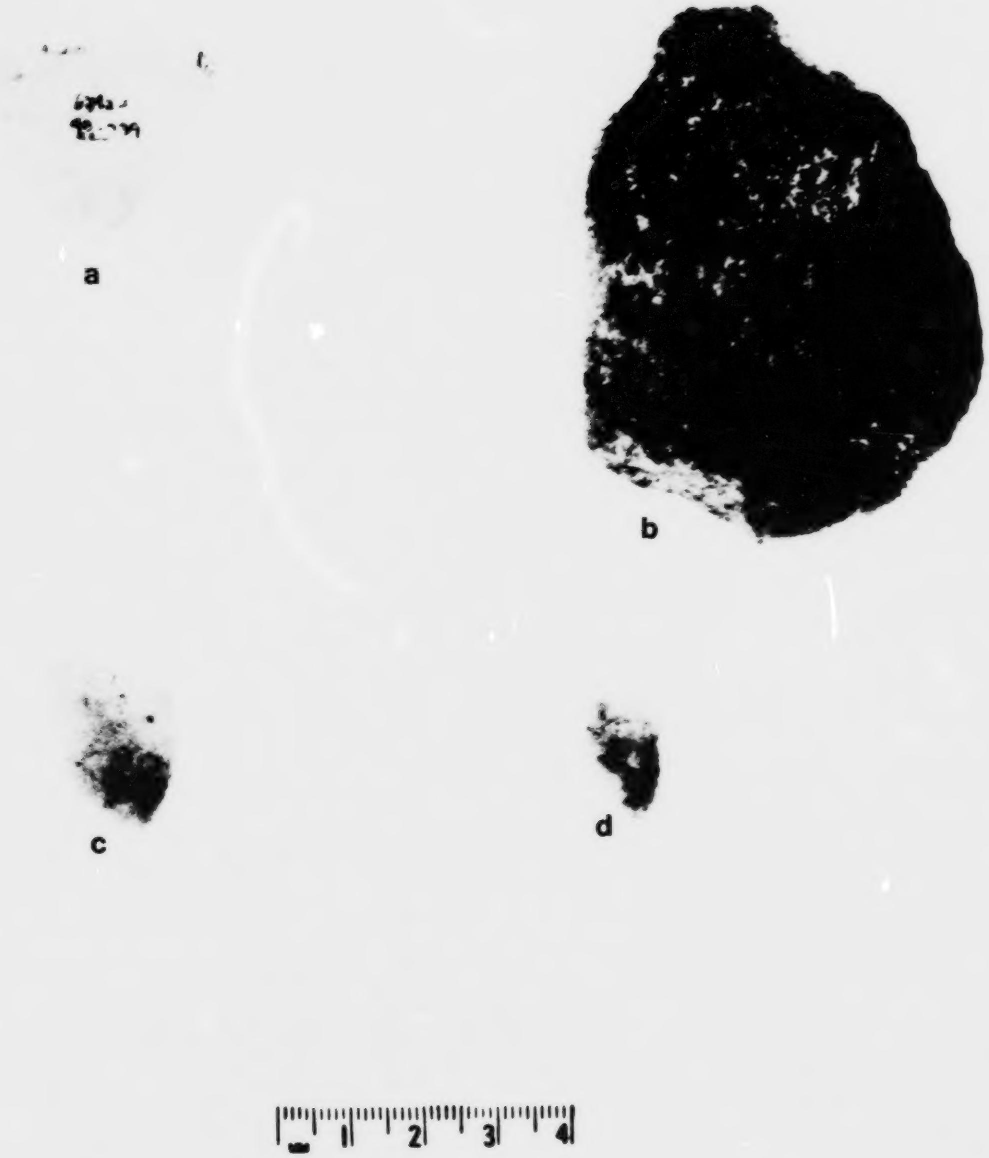


Figure 64. Rough bifaces from Area F.

Figure 65. Utilized flakes from Area F.

(a) 99-282-3
(b) 99-307-1
(c) 100-395-6
(d) 100-467-3
(e) 100-127
(f) 100-325
(g) 101-46
(h) 101-124-3
(i) 101-174-13
(j) 125-39
(k) 125-168

a
b
c
d
e
f
g
h
i
j
k
1
2
3
4

Figure 65. Utilized flakes from Area F.

Figure 66. Fine unifaces from Area F.

(a) 99-154
(b) 99-157
(c) 99-238
(d) 100-396
(e) 100-56
(f) 100-302
(g) 100-327
(h) 101-218

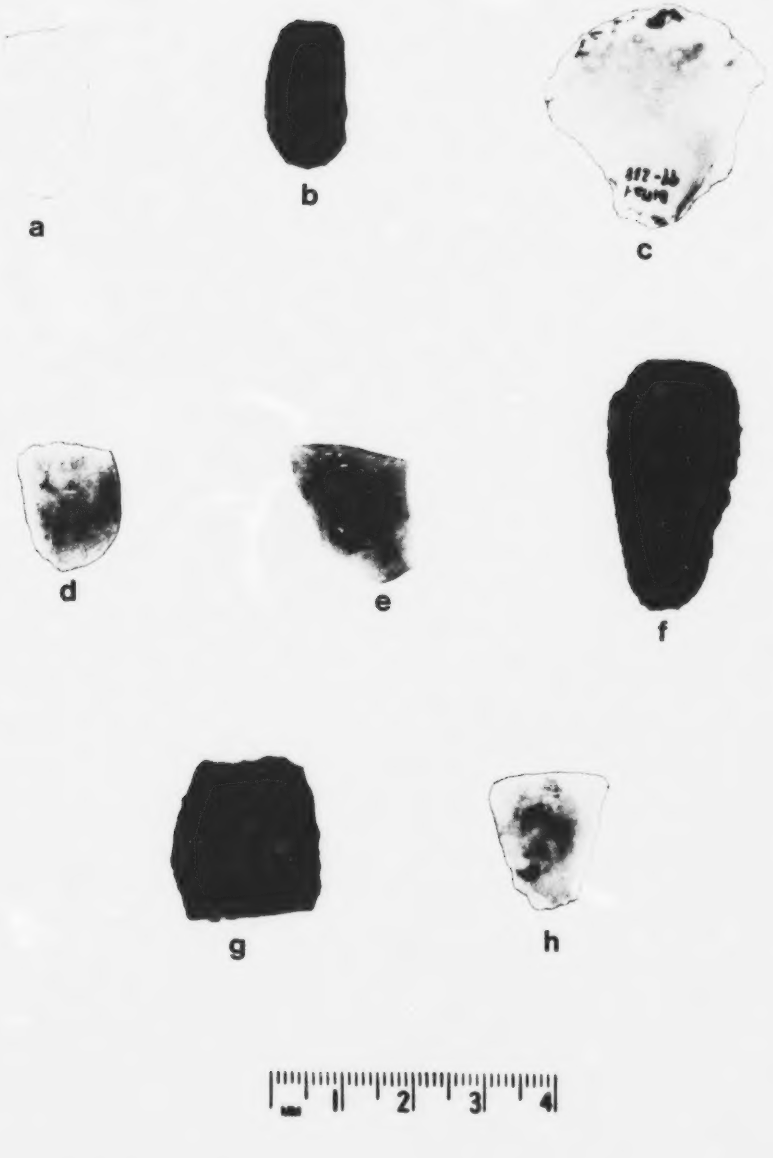

a
b
c
d
e
f
g
h
1
2
3
4

Figure 66. Fine unifaces from Area F.

Figure 67. Fine bifaces from Area F.

(a) 100-395-5
(b) 101-182
(c) 125-171

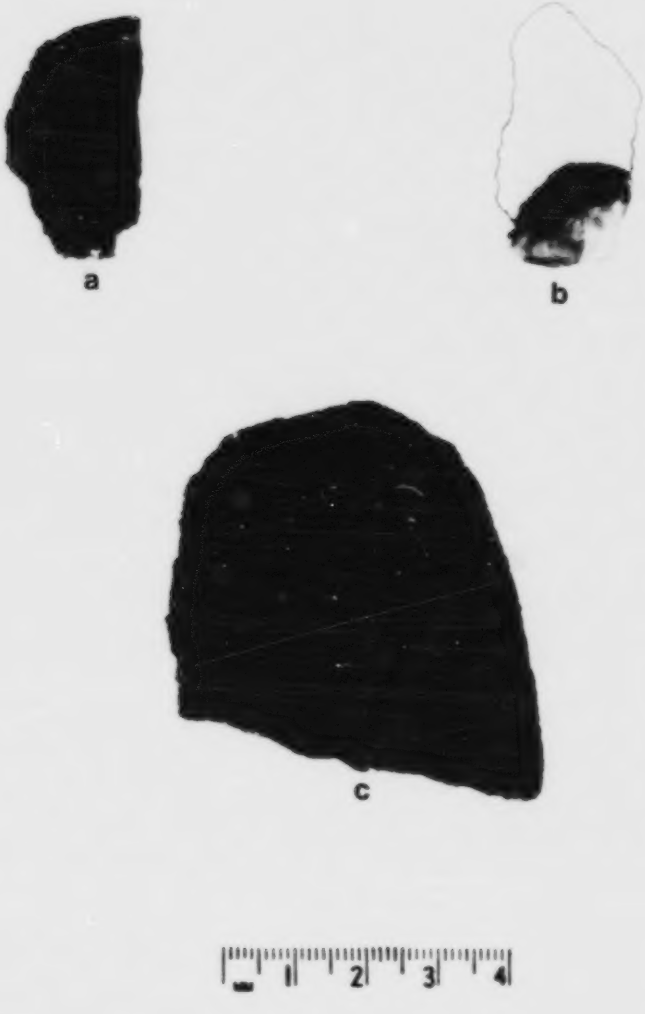


Figure 67. Fine bifaces from Area F.

Figure 68. Projectile points from Area Upper B.

(a) 111-37
(b) 116-5
(c) 117-108
(d) 117-107
(e) 118-58

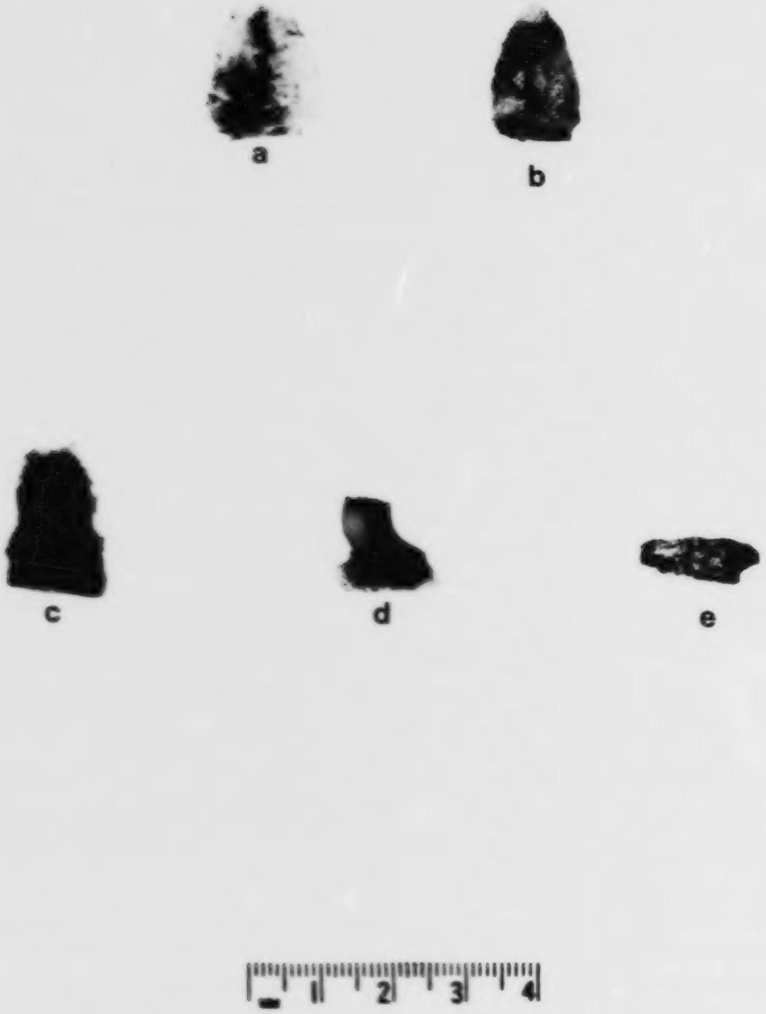


Figure 68. Projectile points from Area Upper B.

Figure 69. Projectile points from Area F.

(a) 99-48
(b) 99-51
(c) 99-91
(d) 99-153
(e) 99-155
(f) 99-161
(g) 99-244
(h) 99-248
(i) 99-340
(j) 100-88
(k) 100-126
(l) 100-189
(m) 100-304
(n) 100-305
(o) 100-308
(p) 100-328
(q) 100-309
(r) 100-343
(s) 101-15
(t) 101-78
(u) 101-180
(v) 101-237
(w) 101-295
(x) 103-10

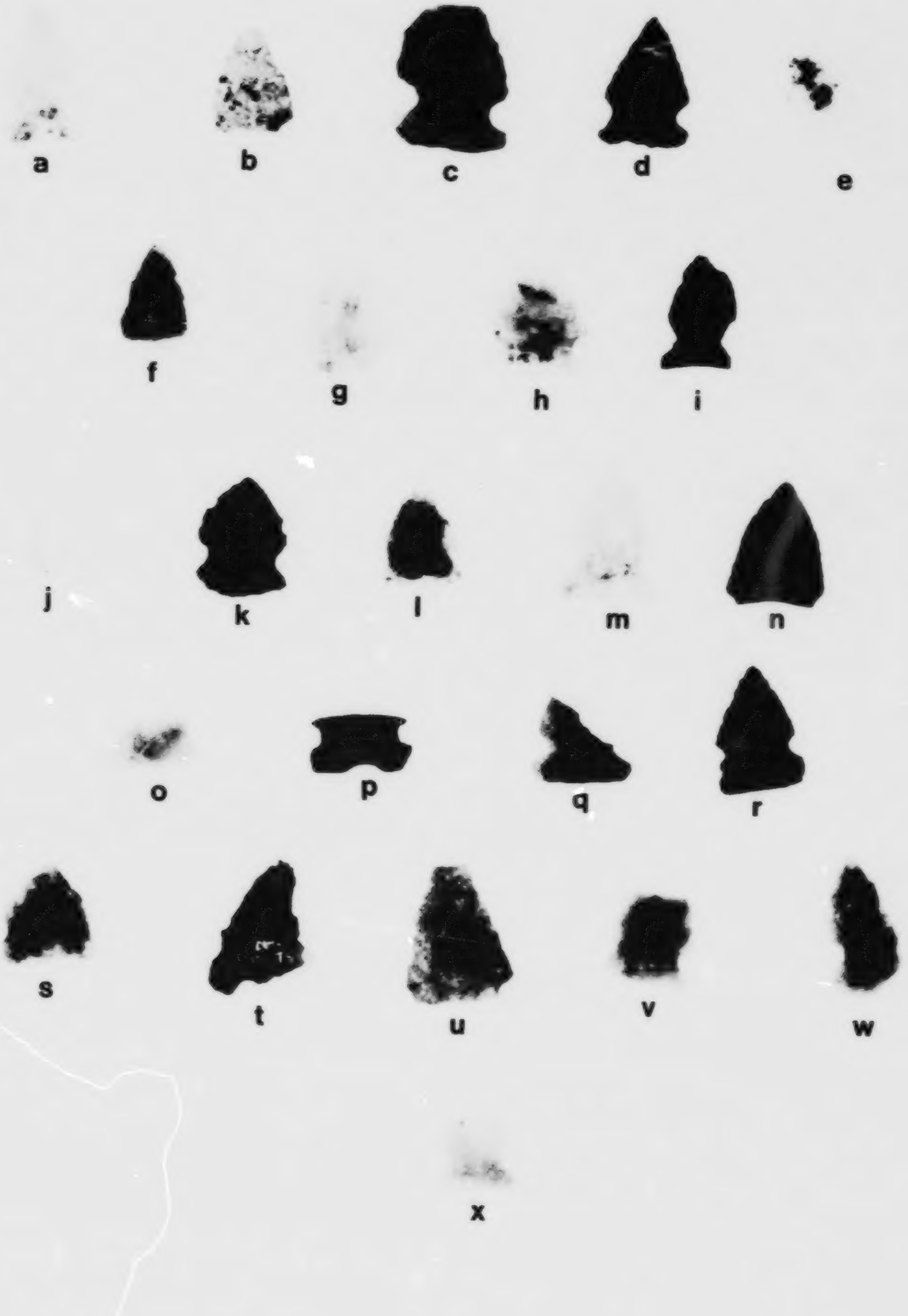

a
b
c
d
e
f
g
h
i
j
k
l
m
n
o
p
q
r
s
t
u
v
w
x

Figure 69. Projectile points from Area F.

Quite a broad range of raw materials was represented among the lithic tools recovered from Areas Upper B and F. Of all the tools recovered, 40.7% were fashioned of Swan River Chert. Together with Knife River Flint, Porcellanite and Chalcedony, these four accounted for 73.2% of the raw materials utilized for tools. Table 39 details the distribution of raw materials within the two excavation areas.

TABLE 39

DISTRIBUTION OF RAW MATERIALS FOR ALL LITHIC TOOLS BY EXCAVATION AREA

RAW MATERIAL	AREA UPPER B		AREA F		TOTAL	
	Number	Per Cent	Number	Per Cent	Number	% All Materials
Quartz	0	0.0	2	100.0	2	0.8
Neutral Quartz	0	0.0	1	100.0	1	0.4
Swan River Chert	6	6.1	93	93.9	99	40.7
Jasper	1	11.1	8	88.9	9	3.7
Petrified Wood	0	0.0	6	100.0	6	2.5
Chalcedony	3	15.8	16	84.2	19	7.8
Knife River Flint	10	25.0	30	75.0	40	16.5
Agate	1	10.0	9	90.0	10	4.1
Porcellanite	2	10.0	18	90.0	20	8.2
Granite	0	0.0	2	100.0	2	0.8
Rhyolite	0	0.0	1	100.0	1	0.4
Selkirk Chert	0	0.0	2	100.0	2	0.8
Cathead Chert	2	11.8	15	88.2	17	7.0
Pebble Chert	2	66.7	1	33.3	3	1.2
Undifferentiated Chert	4	50.0	4	50.0	8	3.3

RAW MATERIAL	AREA UPPER B Number	AREA UPPER B Per Cent	AREA F Number	AREA F Per Cent	TOTAL Number	TOTAL % All Materials
Hudson Bay Lowland Chert	0	0.0	2	100.0	2	0.8
Silicified Sediment	0	0.0	1	100.0	1	0.4
Unidentified	0	0.0	1	100.0	1	0.4
	31		212		243	99.8

When the distribution of raw materials for each artifact class within the two excavation areas is examined (Tables 40 - 43), significant differences are revealed. As detailed in Table 44, Swan River Chert is utilized more than twice as much in Area F than in Upper B, while Knife River Flint demonstrates exactly the opposite characteristics. Other distributions are similar between the two areas, excepting Pebble and Undifferentiated Cherts, which also occur more frequently in Area Upper B. Additionally, slightly more than 8% of the lithic materials recovered were found only in Area F.

TABLE 40

DISTRIBUTION OF RAW MATERIALS BY ARTIFACT CLASS IN AREA UPPER B

	SWAN RIVER CHERT	JASPER	CHALCE-DONY	KNIFE RIVER FLINT	AGATE	PORCEL-LANITE	CATHEAD CHERT	P CHERT	UND CHERT	TOTAL
Core	2	0	0	0	1	0	0	1	1	5
Core Fragment	1	0	0	0	0	0	1	0	0	2
Rough Uniface	0	1	2	2	0	0	0	1	0	6
Rough Biface	0	0	0	0	0	0	0	0	1	1
Rough Biface Fragment	0	0	0	0	0	0	0	0	1	1
Utilized Flake	3	0	1	2	0	1	0	0	0	7
Fine Uniface	0	0	0	1	0	0	0	0	0	1
Fine Uniface Fragment	0	0	0	1	0	0	0	0	0	1
Fine Biface	0	0	0	0	0	1	0	0	0	1
Fine Biface Fragment	0	0	0	0	0	0	1	0	0	1
Projectile Point Fragment	0	0	0	4	0	0	0	0	1	5
	6	1	3	10	1	2	2	2	4	31

TABLE 41

DISTRIBUTION OF RAW MATERIALS BY ARTIFACT CLASS IN AREA F

	QUARTZ	N QUARTZ	SWAN RIVER CHERT	JASPER	PETRI-FIED WOOD	CHALCE-DONY	KNIFE RIVER FLINT	AGATE	PORCEL-LANITE	RHYOLITE
Core	0	0	18	1	0	2	1	0	1	0
Core Fragment	0	1	8	1	0	1	0	0	0	0
Rough Uniface	1	0	9	2	2	1	3	0	2	0
Rough Uniface Fragment	0	0	3	1	1	1	1	1	1	0
Rough Biface	0	0	4	1	0	0	0	0	0	0
Rough Biface Fragment	0	0	7	0	0	2	2	1	0	0
Utilized Flake	0	0	28	1	2	3	4	2	4	0
Utilized Blade	0	0	1	0	0	0	2	0	0	0
Fine Uniface	0	0	1	1	0	1	3	3	3	0
Fine Uniface Fragment	0	0	0	0	0	0	3	0	1	0
Fine Biface	0	0	0	0	0	0	0	1	0	0
Fine Biface Fragment	0	0	1	0	1	1	1	0	0	0
Projectile Point	1	0	2	0	0	1	5	0	2	1
Projectile Point Fragment	0	0	11	0	0	3	5	1	4	0
	2	1	93	8	6	16	30	9	18	1

TABLE 41, CONTINUED

	SWAN RIVER CHERT	CATHEAD CHERT	P CHERT	UNO CHERT	HBL CHERT	SILIC SEDIMENT	GRANITE	UNID	TOTAL
Core	0	3	0	0	1	0	0	0	27
Core Fragment	0	0	1	1	0	0	0	0	13
Rough Uniface	0	1	0	1	0	0	0	0	22
Rough Uniface Fragment	0	0	0	0	0	0	0	0	9
Rough Biface	0	1	0	0	0	0	0	0	6
Rough Biface Fragment	0	1	0	0	0	1	0	0	14
Utilized Flake	2	2	0	0	0	0	1	0	49
Utilized Blade	0	1	0	0	0	0	0	0	4
Fine Uniface	0	0	0	0	0	0	0	0	12
Fine Uniface Fragment	0	1	0	0	0	0	0	0	5
Fine Biface	0	0	0	0	0	0	0	0	1
Fine Biface Fragment	0	0	0	0	0	0	1	0	5
Projectile Point	0	1	0	0	0	0	0	1	14
Projectile Point Fragment	0	4	0	2	1	0	0	0	31
	2	15	1	4	2	1	2	1	212

TABLE 42

POPULARITY OF LITHIC RAW MATERIALS IN AREA UPPER B

RAW MATERIAL	NUMBER TOOLS	PERCENTAGE OF TOTAL
Swan River Chert	6	19.4
Jasper	1	3.2
Chalcedony	3	9.7
Knife River Flint	10	32.3
Agate	1	3.2
Porcellanite	2	6.5
Cathead Chert	2	6.5
Pebble Chert	2	6.5
Undifferentiated Chert	4	12.9
	31	100.2

TABLE 43

POPULARITY OF LITHIC RAW MATERIALS IN AREA F

RAW MATERIAL	NUMBER TOOLS	PERCENTAGE OF TOTAL
Quartz	2	.9
Neutral Quartz	1	.5
Swan River Chert	93	43.9
Jasper	8	3.8
Petrified Wood	6	2.8
Chalcedony	16	7.5
Knife River Flint	30	14.2
Agate	9	4.2
Porcellanite	18	8.5
Rhyolite	1	.5
Selkirk Chert	2	.9
Cathead Chert	15	7.1
Pebble Chert	1	.5
Undifferentiated Chert	4	1.9
Hudson Bay Lowland Chert	2	.9
Silicified Sediment	1	.5
Granite	2	.9
Unidentified	1	.5
	212	100.0

TABLE 44

PERCENTAGE DISTRIBUTION OF LITHIC RAW MATERIALS BY AREA

RAW MATERIAL	AREA UPPER B	AREA F
Swan River Chert	19.4	43.9
Jasper	3.2	3.8
Chalcedony	9.7	7.5
Knife River Flint	32.3	14.2
Agate	3.2	4.2
Porcellanite	6.5	8.5
Cathead Chert	6.5	7.1
Pebble Chert	6.5	.5
Undifferentiated Chert	12.9	1.9
Remaining Materials	0.0	8.4
	100.2	100.0

Throughout the 40 years of archaeological investigation at the Stott Site, projectile points have proved to be a more prolific diagnostic item of recovery than ceramic vessels. In contrast to the seemingly unique styles and/or decorative patterns of many pottery vessels at DlMa-1, it has been possible to classify most complete projectile points within the established typological systems devised by Forbis for recoveries from Old Women's Buffalo Jump in Alberta (1962) and Kehoe for lithic materials from Saskatchewan and Montana bison kill sites (1966; 1967; 1973). In addition to the definition of types and varieties on the basis of quantifiable data, there is also a series of radiocarbon dates associated with these lithic materials providing a time frame for most of the projectile points. Although it might be overly optimistic to expect a direct correspondence, either typologically or chronologically, between materials from sites so far apart geographically, projectile points recovered at DlMa-1 can be placed within these typologies with relative ease.

Bev Nicholson (1976) pioneered work in this area for projectile points from the Stott Site. Relying upon six of the seven attributes identified as significant by Kehoe at the Boarding School Bison Drive Site (1967:42), he examined points retrieved by Bird (1947), MacNeish (1954) and the 1975 Field School from Area G (see Figure 2). Of the 158 points examined, Nicholson could place 122 of them into Kehoe's system, with the addition of the Stott Corner-notched variety described first by MacNeish (1954:40) and two minor varieties, Style UM-1 and Form LM-4 discussed by Forbis for Old Women's Buffalo Jump (1962:103, 113). Hamilton (1981:132-141) also placed the projectile points recovered from Area F in 1979 within Nicholson's scheme. Of the 105 complete and partial points retrieved, 70 could be placed within the existing typology. Area F Field School excavations in 1979 also produced 13 projectile points (Syms et al. 1979:130), but only four of these were discussed in the student reports. Table 45 summarizes the distribution of projectile point types and varieties recovered from the farm portion of the Stott Site, along with proposed time frames as suggested by radiocarbon dates. The two radiocarbon dates determined from bone found at the base of the bone bed in Area G returned dates of A.D. 840 ± 60 (S1272) and A.D. 910 ± 45 (S1273) (Syms 1976:30). These dates do not seem inappropriate for the projectile point types recovered in Area G, considering the projected time frames for these types at other sites on the Northern Plains. Only the Pelican Lake and Avonlea recoveries appear anomalous among the classified items.

TABLE 45

PROJECTILE POINT TYPOLOGY AND CHRONOLOGY FOR AREAS F AND G

PROJECTILE POINT TYPES AND VARIETIES	Area G[a]	AREA F		TIME FRAME
		1979[b]	1979/FS[c]	
Pelican Lake	1	0	0	B.C. 1000 - A.D. 1 (Reeves 1970:160-161)
Avonlea	0	0	0	
- Classic/Gull Lake	2	0	0	A.D. 200 (Kehoe 1967:53)
- Carmichael Wide-Eared	1	1	0	Post A.D. 800 (Kehoe 1967:53)
- Timber Ridge Sharp-Eared	1	1	1	A.D. 6-700 (Kehoe 1967:55)
Prairie Side-Notched	0	0	1	
- Irvine Narrow Square Base	1	18	0	A.D. 6-1200 (Forbis 1962:102); Post A.D. 750 (Kehoe 1967:58)
- Lewis Narrow Rounded-Base	2	0	0	A.D. 6-1600 (Forbis 1962:100) A.D. 6-1350 (Forbis 1962:102)
- High River Small-Corner-Notched	14	5	1	Post A.D. 750 (Kehoe 1967:59)
- Tomkins Side-Corner-Notched	9	5	0	A.D. 800 (Kehoe 1967:59)
- Nanton Wide Rounded-Base	28	22	0	A.D. 6-1700 (Forbis 1962:100)
- Stott Corner-Notched	9	2	0	Early Historic (MacNeish 1954:40)[d]
- Form LM-4	3	0	0	
- Style UM-1	1	1	0	
- Swift Current Fish-Tail	0	2	0	A.D. 800 (Kehoe 1967:51)
Plains Side-Notched	0	1	0	
- Pekisko Concave-Base V Notched	16	0	0	A.D. 1200-Protohistoric (Forbis 1962:98)

TABLE 45 CONTINUED

PROJECTILE POINT	Area G[a]	AREA F 1979[b]	 1979/FS[c]	TIME FRAME
- Emigrant Basal-Notched	4	0	0	
- Paskapoo Square-Ground Base	0	1	1	A.D. 1000-Protohistoric (Forbis 1962:99); Post A.D. 1590 (Kehoe 1967:61)
Plains Triangular				
- NT-1	8	4	0	Late Prehistoric (MacNeish 1954:38)
- NT-2	10	5	0	
- NT-3	4	2	0	

[a] Figures from Nicholson 1976:60.
[b] Figures from Hamilton 1981:137.
[c] Figures from Syms et al. 1979:39; 60.
[d] Time of site judged to be early historic on the erroneous assumption that the copper bead found by Bird in Area G in 1947 in Test Pit 2 had to be of European origin. See Tisdale 1978:125-26.

Of the 45 projectile points and fragments recovered from excavations in Area F in 1982, only 18 are whole enough to be classified with any certainty. With the exception of point 100-88, a small agate flake/point that was worked bifacially on only one lateral edge, all other points fall readily into the Prairie/Plains Side-Notched or Plains Triangular categories. Table 46 details the classification of projectile points recovered from Area F in 1982.

When the distribution of various point types and varieties are compared between Areas F and G, some interesting differences appear (Table 47). Of the chronologically early points, the only Pelican Lake specimen is found in Area G, while the Avonlea recoveries are divided relatively equally between the two areas (4 in Area G; 3 in Area F). The number of points classified within the Prairie Side-Notched system is nearly equal between the

TABLE 46

1982 PROJECTILE POINT TYPOLOGY FOR AREA F

UNIT	CATALOGUE NUMBER	PROVENIENCE (CM)	RAW MATERIAL	CLASSIFICATION
99	48	8.6 DBS	Swan River Chert	Nanton Wide Rounded Base
	91	11.0 DBS	Cathead Chert	Tompkins Side-Corner Notched
	153	23.0 DBS	Porcellanite	Nanton Wide Rounded Base
	155	25.0 DBS	Chalcedony	Irvine Narrow Square-Base
	248	25-30 DBS	Knife River Flint	Irvine Narrow Square-Base
	340	85.0 DBS	Unidentified	High River Small-Corner-Notched
100	88	15.0 DBS	Agate	Unclassified
	126	15-20 DBS	Porcellanite	Stott Corner-Notched
	189	20-25 DBS	Knife River Flint	Nanton Wide Rounded-Base
	304	33.5 DBS	Swan River Chert	Nanton Wide Rounded-Base
	309	30-35 DBS	Knife River Flint	Emigrant Basal-Notched
	328	35-40 DBS	Cathead Chert	Nanton Wide Rounded-Base
	343	40-45 DBS	Rhyolite	Nanton Wide Rounded-Base
101	15	7.0 DBS	Knife River Flint	Irvine Narrow Square-Base
	180	30.0 DBS	Swan River Chert	Plains Triangular NT-3
	237	36.0 DBS	Swan River Chert	Nanton Wide Rounded-Base
	295	Level 2/ Balk	Knive River Flint	UM-1
103	10	4.0 DAS	Swan River Chert	Irvine Narrow Square-Base

the areas (67 for G; 72 for F), but among the varieties of Prairie Side-Notched projectile points, differential distribution is apparent. For example, over 95% of the Irvine Narrow Square-Base specimens were recovered in Area F (22 of 23). However, other than the 67% recovery of Style UM-1 and the 100% recovery of Swift Current Fish-Tail in Area F, all other varieties of Prairie Side-Notched Projectile Points are found in equal or greater proportion in Area G. All of the Lewis Narrow Rounded-Base and Form LM-4 points were located in Area G. As well, two-thirds of the High River Small-Corner Notched and Stott Corner-Notched points were recovered in Area G.

TABLE 47

DISTRIBUTION OF POINT TYPES FROM THE FARM PORTION OF DlMa-1

POINT CLASSIFICATION	AREA G		AREA F 1979[a]		AREA F 1982	
	#	%	#	%	#	%
Pelican Lake	1	100.0	0	0.0	0	0.0
Avonlea						
Gull Lake/Classic	2	100.0	0	0.0	0	0.0
Carmichael Wide-Eared	1	50.0	1	50.0	0	0.0
Timber Ridge Sharp-Eared	1	33.3	2	66.7	0	0.0
Prairie Side-Notched	0	0.0	1	100.0	0	0.0
Irvine Narrow Square-Base	1	4.4	18	78.3	4	17.4
Lewis Narrow Rounded-Base	2	100.0	0	0.0	0	0.0
High River Small-Corner-Notched	14	66.7	6	28.6	1	4.8
Tompkins Side-Corner-Notched	9	60.0	5	33.3	1	6.7
Nanton Wide Rounded-Base	28	49.1	22	38.6	7	12.3
Stott Corner-Notched	9	75.0	2	16.7	1	8.3
Form LM-4	3	100.0	0	0.0	0	0.0
Style UM-1	1	33.3	1	33.3	1	33.3
Swift Current Fish-Tail	0	0.0	2	100.0	0	0.0
Plains Side-Notched	0	0.0	1	100.0	0	0.0
Pekisko Concave-Base V Notched	16	100.0	0	0.0	0	0.0
Emigrant Basal-Notched	4	80.0	0	0.0	1	20.0
Paskapoo Square-Ground Base	0	0.0	2	100.0	0	0.0
Plains Triangular						
NT-1	8	66.7	4	33.3	0	0.0
NT-2	10	66.7	5	33.3	0	0.0
NT-3	4	57.1	2	28.6	1	14.3

[a] Combined total for the Field School and Hamilton recoveries in 1979.

Distribution of Nanton Wide Rounded-Base points is virtually equal (49.1% in Area G; 50.9% in Area F) between the two areas, while Tompkins Side-Corner-Notched points are divided 60% to 40% between them. Within the Plains Side-Notched type of projectile point, 83% of all varieties combined occurred in Area G. Among the Plains Triangular varieties, however, only 65% occurred in Area G.

Only five projectile point fragments were retrieved from Area Upper B in 1982 (Figure 68). Unfortunately, none of these were complete enough for type assessment. As none of the other points recovered from Grand Valley Provincial Park in 1977 and 1981 had been assessed either, these materials were also placed within the point typology in order to compare type distribution between the farm and park portions of the site. A total of 36 complete and fragmentary projectile points were recovered from the Park in 1977 and 1981. Of these, 20 were complete enough to be placed within the existing typology (Table 48; Figures 70-72).

TABLE 48

DISTRIBUTION OF POINT TYPES FROM THE PARK PORTION OF DlMa-1

AREA	UNIT	CATALOGUE NUMBER	CLASSIFICATION
A	12	12-3-1	Irvine Narrow Square-Base
	15	15-6-5	Irvine Narrow Square-Base
Upper B	33	33-6-5	Unclassified
	33	33-11-1	Nanton Wide Rounded-Base
	34	34-7-2	Shaunavon Truncated Base
	38	38-10-3	Tompkins Side-Corner-Notched
	40	40-5-3	Stott Corner-Notched
	86	86-D1-359	Nanton Wide Rounded-Base
	86	86-D3-529	Irvine Narrow Square-Base
	87	87-C3-129	Irvine Narrow Square-Base
	87	87-D5-516	Lewis Narrow Rounded-Base
	87	87-D6-640	Irvine Narrow Square-Base
	88	88-C1-26	Nanton Wide Rounded-Base
	89	89-C5-285	Tompkins Side-Corner-Notched
	89	89-C8-464	Tompkins Side-Corner-Notched
Lower B	94	94-B3-172	High River Small Corner-Notched
	96	96-B6-387	Irvine Narrow Square-Base
	96	96-B7-501	Tompkins Side-Corner-Notched
	98	98-B5-260	Tompkins Side-Corner-Notched
	98	98-B5-273	Plains Triangular NT-3

Figure 70. Projectile points from Area A.

(a) 12-3-1
(b) 15-6-5

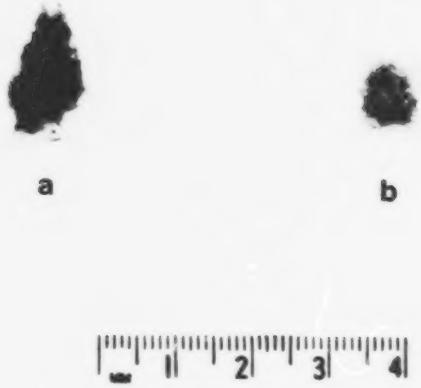


Figure 70. Projectile points from Area A.

Figure 71. Projectile points from Area Upper B.

(a) 33-6-5
(b) 33-11-1
(c) 34-7-2
(d) 38-10-3
(e) 40-5-3
(f) 86-/D1-359
(g) 86-D3-529
(h) 87-C3-129
(i) 87-D5-516
(j) 87-D6-640
(k) 88-C1-26
(l) 89-C5-285
(m) 89-C8-464

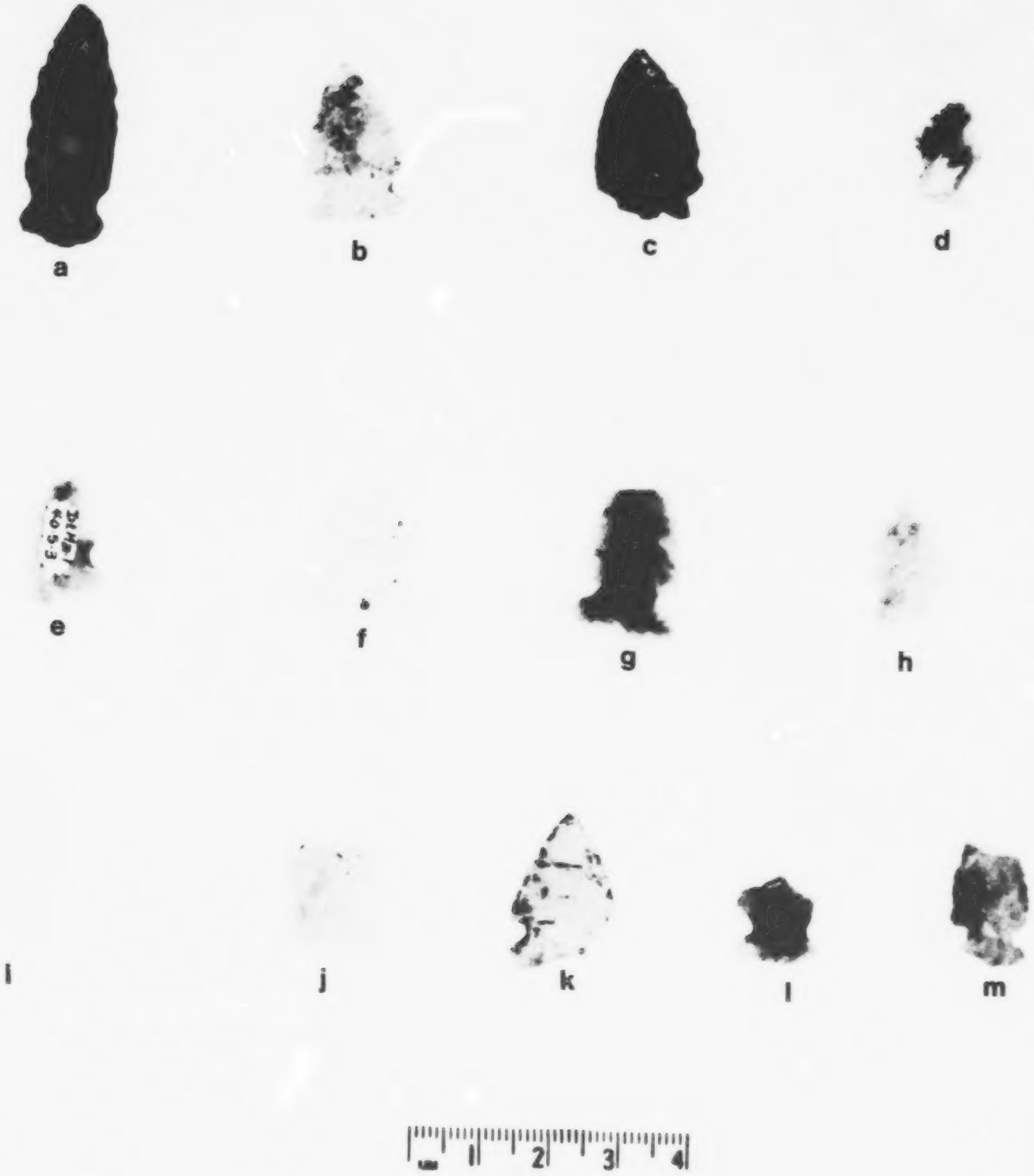

a
b
c
d
e
f
g
h
i
j
k
l
m
1
2
3
4

Figure 71. Projectile points from Area Upper B.

Figure 72. Projectile points from Area Lower B.

(a) 94-B3-172
(b) 96-B6-387
(c) 96-B7-501
(d) 98-B5-260
(e) 98-B5-273

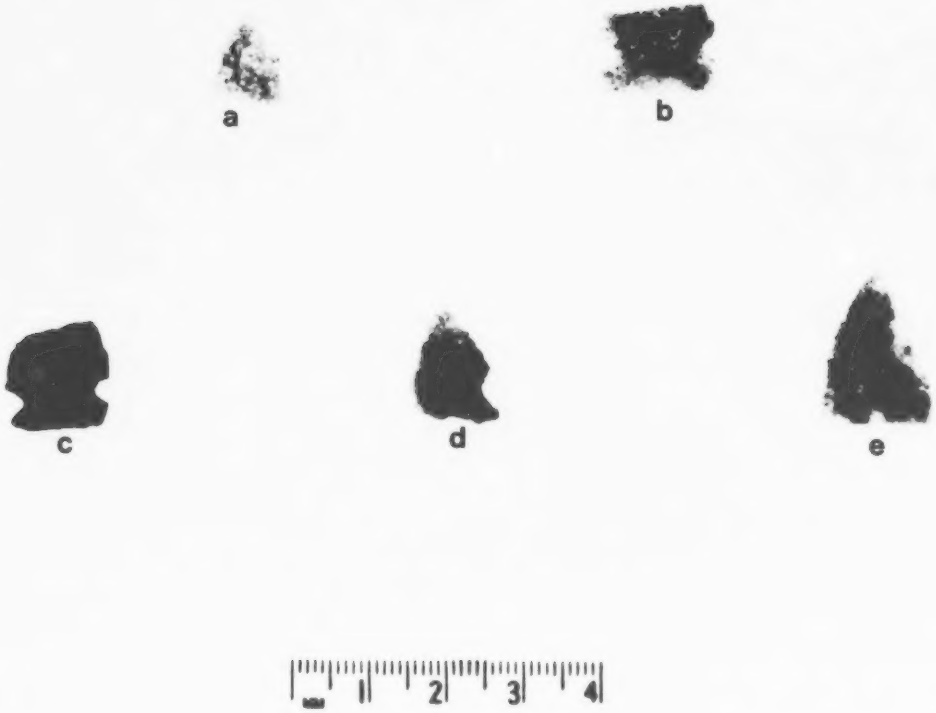


Figure 72. Projectile points from Area Lower B.

A comparison of the distribution of projectile point types and varieties among the five excavation areas (Table 49) reveals some interesting patterns. The Pelican Lake and Avonlea points, which are considered to predate the small side-notched specimens, are confined to the farm portion of the site in Areas F and G. As well, with the exception of one point, all of the Plains Side-Notched and Plains Triangular items are located west of the TransCanada Highway in Areas F and G. In general, these types are considered to be chronologically later than the Prairie Side-Notched type and its varieties. If all of the five excavation areas are considered, distribution of the Prairie Side-Notched projectile points is altered somewhat from that delineated in Table 47. The Irvine Narrow Square-Base variety is still concentrated in Area F, but also appears in the three excavation areas within the Park; in Area A, it is the only type recovered. Within the Park, Area Upper B contains Lewis Narrow Rounded-Base, Nanton Wide Rounded-Base and Stott Corner-Notched specimens similar to those found in Areas F and G. As well, the only occurrence of a Shaunavon Truncated projectile point is in Area Upper B. Areas Upper and Lower B both contain examples of Tompkins Side-Corner-Notched points, like those found in Areas F and G. The only High River Small-Corner-Notched specimen found in the Park was retrieved from Area Lower B.

If the distribution of projectile point types is compared with that of ceramic vessels, a parallel situation can be observed to exist between these two major classes of artifacts. Although vertical stratigraphy must be regarded with suspicion at DlMa-1, horizontal stratigraphy appears more reliable. Of the proposed non-Blackduck pottery, incised and Mode X vessels cluster in Area F, with dentate stamped and dentate stamped/bossed vessels grouped in Area Lower B. Similarly, there appear to be clusters of relatively early (Pelican Lake/Avonlea) and late (Plains Side-Notched/Plains Triangular) points in Areas F and G. Within the Prairie Side-Notched type, individual varieties also appear to cluster somewhat, e.g. Irvine Narrow Square-Base points in Area F.

TABLE 49

DISTRIBUTION OF POINT TYPES BY AREA AT D1Ma-1

POINT CLASSIFICATION	AREA A		UPPER B		LOWER B		AREA F		AREA G	
	#	%	#	%	#	%	#	%	#	%
Pelican Lake	0	0.0	0	0.0	0	0.0	0	0.0	1	100.0
Avonlea										
Gull Lake/Classic	0	0.0	0	0.0	0	0.0	0	0.0	2	100.0
Carmichael Wide-Eared	0	0.0	0	0.0	0	0.0	1	50.0	1	50.0
Timber Ridge Sharp-Eared	0	0.0	0	0.0	0	0.0	2	66.7	1	33.3
Prairie Side-Notched	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
Irvine Narrow Square-Base	2	6.9	3	10.3	1	3.5	22	75.9	1	3.5
Lewis Narrow Round-Base	0	0.0	1	33.3	0	0.0	0	0.0	2	66.7
High River Small Corner-Notched	0	0.0	0	0.0	1	4.5	7	31.8	14	63.6
Tompkins Side-Corner Notched	0	0.0	3	15.0	2	10.0	6	30.0	9	45.0
Nanton Wide Rounded-Base	0	0.0	3	5.0	0	0.0	29	48.3	28	46.7
Stott Corner-Notched	0	0.0	1	7.7	0	0.0	3	23.1	9	69.2
Form LM-4	0	0.0	0	0.0	0	0.0	0	0.0	3	100.0
Style UM-1	0	0.0	0	0.0	0	0.0	2	66.7	1	33.3
Swift Current Fish Tail	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0
Shaunavon Truncated	0	0.0	1	100.0	0	0.0	0	0.0	0	0.0
Plains Side-Notched	0	0.0	0	0.0	0	0.0	1	100.0	0	0.0
Pekisko Concave-Base V Notch	0	0.0	0	0.0	0	0.0	0	0.0	16	100.0
Emigrant Basal-Notched	0	0.0	0	0.0	0	0.0	1	20.0	4	80.0
Paskapoo Square-Ground-Base	0	0.0	0	0.0	0	0.0	2	100.0	0	0.0
Plains Triangular										
NT-1	0	0.0	0	0.0	1	7.7	4	30.8	8	61.5
NT-2	0	0.0	0	0.0	0	0.0	5	33.3	10	66.7
NT-3	0	0.0	0	0.0	0	0.0	3	42.9	4	57.1

FAUNA

A total of 28 bone artifacts were recovered in 1982, all but two of which came from Area F (Table 50; Figures 73 and 74). This concentration of bone tools in the farm portion of the site parallels a similar concentration of ceramic and lithic artifacts in 1982. Previous excavations in the park during 1977 and 1981 produced similar lower rates of bone tool recoveries. Only five bone artifacts were reported for all areas of the site in 1977 (Tisdale 1978:46; 48; 53) and no tools were reported from the 1981 excavations; 36 bone tools were reported from Hamilton's 1979 excavations (1981:217) on the farm side of the site.

TABLE 50

DISTRIBUTION OF BONE TOOLS BY AREA

AREA	NUMBER OF BONE TOOLS	PERCENTAGE BONE TOOLS
Upper B	2	7.1
F	26	92.9

The purposes for which these few tools were manufactured is not always clear, for the artifacts are not specific and in most cases only slightly modified from the original bone. There were no polished fleshers, perforated fragments, unilaterally barbed lances or handles with lithic scrapers as reported by MacNeish for Area G (1954:64; 65). Nor were there any straight awls, rectangular bone pendants/needles, drilled vertebra or ovate-grooved thoracic spine tools as described by Hamilton (1981:216-242) for Area F.

In order to make the bone artifacts as comparable as possible, the classification system employed by Hamilton (1981:216-219) was also used for the 1982 materials. In the 1982 bone tool recoveries, there were artifacts

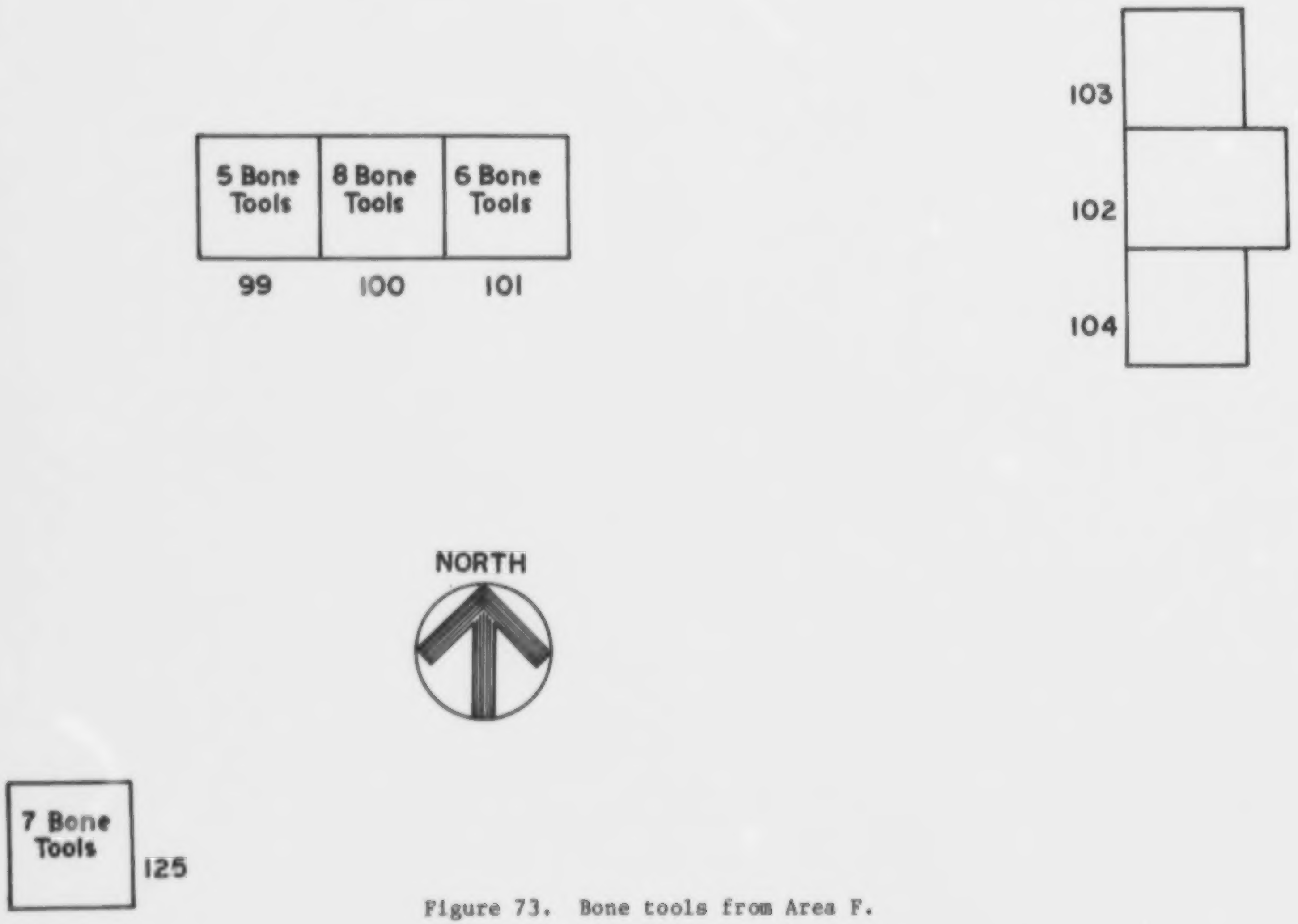

103
102
104
5 Bone Tools
8 Bone Tools
6 Bone Tools
99
100
101
NORTH
7 Bone Tools
125

Figure 73. Bone tools from Area F.

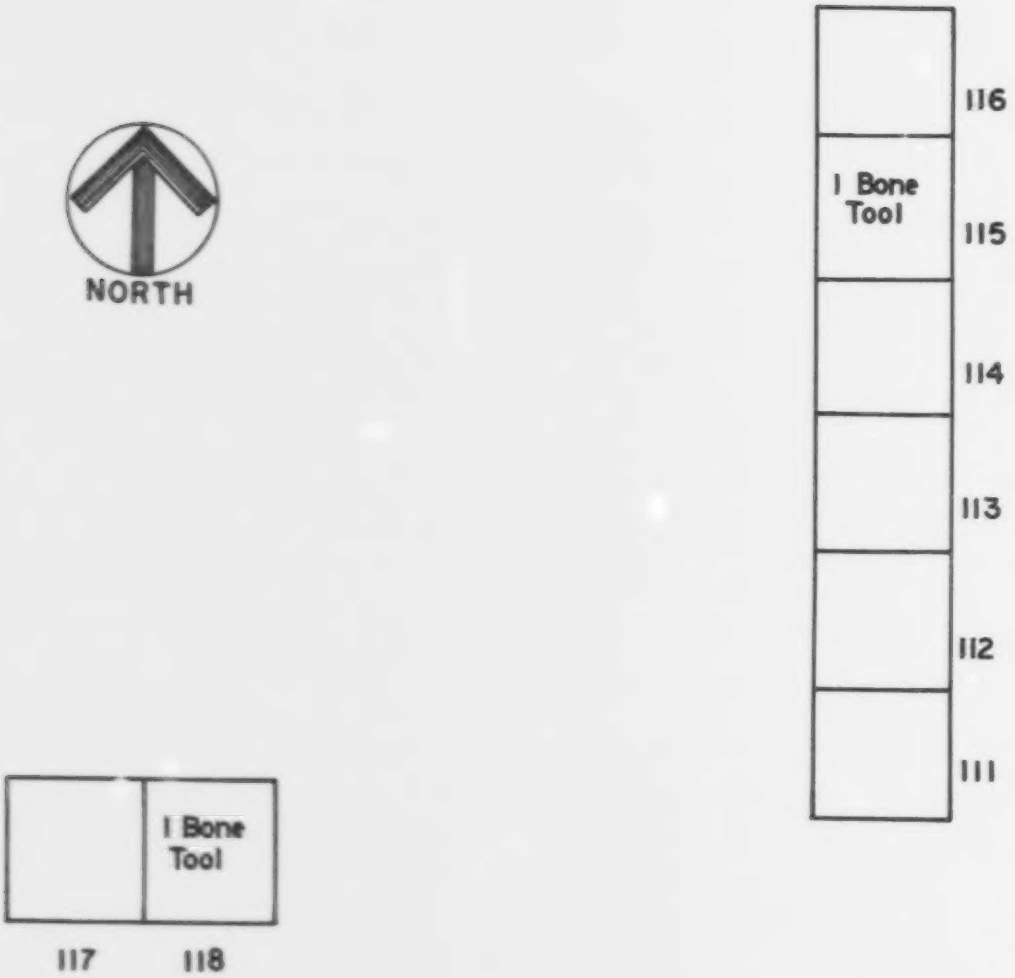

NORTH
116
1 Bone Tool
115
114
113
112
111
1 Bone Tool
117
118

Figure 74. Bone tools from Area Upper B.

which could be classified as awl-like (8), spatulate (8), grooved by-products of tool manufacture (3), a grooved pendant/tool (1), a bead or whistle (1), and fleshing/butchering tools (7). All bone artifacts recovered in 1982 are listed by class, catalogue number and provenience in Table 51.

Awl-Like Artifacts - Eight artifacts have been classified as awl-like (Figure 75). Three of these are made from ribs and have abraded tips, two with narrow blunt ends (99-311-1 and 100-489-11) and one with a round pointed end (99-1-8). An additional three of the awls are made of extremity shaft bone, each having a polished point with flakes removed from it, either during manufacture or use. The three ends have different shapes: one is pointed (100-222-3); one is rounded (118-104-2); and the third is also rounded, but blunt (100-400-37). The final two awl-like artifacts are only tentatively classified as such. A small to medium sized mammal rib (101-183-12) bears abrasions placed obliquely on the long axis of the bone, forming a tapered proximal end which, unfortunately, is broken. The second tapered artifact (101-131-61) is made from an unclassifiable mammal bone. It is highly polished on one side with abrasions placed perpendicular to the long axis of the bone. Some grooves form a wide "v" pattern on the polished surface; perhaps it was used as a decorative item.

Spatulate Artifacts - All of the spatulate tools are fashioned from the ribs of medium to large, and large-sized mammals (Figure 76). Five of the ribs have been broken at mid-shaft and are worn only at one end on the medial surfaces (99-167-22; 100-400-21; 100-400-28; 101-220-15; 125-185). The remaining items are rib fragments, two with rounded blunt ends (100-222-4 and 101-326-8) and one with a blunt end (100-311-12).

TABLE 51

BONE ARTIFACTS RECOVERED IN 1982

ARTIFACT TYPE	UNIT	CO-ORDINATES	CATALOGUE NUMBER	PROVENIENCE (CM)
Awl-Like				
Abraded	99	0N 104E	99-1-8 99-311-1	0-5 DBS 40-45 DBS
	100	0N 105E	100-489-11	Level 4/Balk
Flaked	100	0N 105E	100-222-3 100-400-37	29 DBS Level 2/Balk
	118	15S 46W	118-104-2	21-30 DBS
Tapered	101	0N 106E	101-131-161 101-183-12	25-30 DBS 30-35 DBS
Spatulate	99	0N 104E	99-167-22	25-30 DBS
	100	0N 105E	100-222-4 100-311-12 100-400-21 100-400-28	29 DBS 35-40 DBS Level 2/Balk Level 2/Balk
	101	0N 106E	101-220-15 101-326-8	35-40 DBS Level 4/Balk
	125	8S 93E	125-185	37 DBS
Grooved By-Products of Tool Manufacture	99	0N 104E	99-4	3.5 DBS
	101	0N 106E	101-131-53	25-30 DBS
	125	8S 93E	125-62-9	15-20 DBS
Grooved Pendant	99	0N 104E	99-68	10-15 DBS
Bead/Whistle	125	8S 93E	125-260-3	50-55 DBS
Fleshing/ Butchering	100	0N 105E	100-400-34	Level 2/Balk

ARTIFACT TYPE	UNIT	CO-ORDINATES	CATALOGUE NUMBER	PROVENIENCE (CM)
	101	0N 106E	100-286-21	Level 2/Balk
	115	5S 40W	115-38	49 DBS
	125	8S 93E	125-88	20-25 DBS
			125-128	25-30 DBS
			125-153	35 DBS
			125-206-7	35-40 DBS

Grooved By-products of Tool Manufacture - Three grooved by-products of tool manufacture were recovered, two of which are fashioned from large mammal extremity shafts (99-4 and 125-62-9) and one of which (101-131-53) is a portion of deer antler (Figure 77 e-g). The grooving is obviously a purposeful part of the manufacturing process, because each bone has been snapped off near the groove (99-4 and 101-131-53). Artifact 125-62-9 may have been grooved in order to secure it to another item.

Grooved Pendant/Tool - The grooved pendant/tool (99-68) is made from a very worn medium to large mammal incisor (Figure 77d). The grooves are located on the medial and lateral sides of the tooth root at its junction with the enamel. The tooth surface may have been utilized also, but because there are no "unnatural" wear patterns on the occlusal surface, that possibility cannot be substantiated.

Bead/Whistle - The bead or whistle fragment, 125-260-3, is manufactured from the extremity shaft of a medium to large sized bird (Figure 77c). It is abraded at one end and the shaft is not polished.

Fleshing and Butchering Tools - The fleshing and butchering category includes a sample of those bones which are barely modified and appear to have been utilized as found at the site. They seem analogous to the lithic classification, utilized flake -- a fortuitously located fragment of stone or bone just right for the task at hand without the necessity of actually fashioning a tool. There is little evidence that any of these bones have been modified, other than that they are broken; some exhibit polish and others have flakes removed from the presumed working edges.

-- Artifact 100-400-34 (Figure 77b), a portion of a large mammal extremity shaft, has been used in such a way that one end of the spirally-fractured bone is nearly blunt. Several flakes have been removed from this end, as from pounding. One area of the outer cortex along the side of the bone also appears to have had four long flakes intentionally removed.

-- Artifact 101-286-21 (Figure 77a) is a medium to large sized mammal extremity shaft; very slight polish is exhibited on one of its edges.

-- Artifact 115-38 (Figure 78a) is three-quarters of a bison left tibia shaft. The proximal end, though somewhat damaged during excavation, appears tapered through use and has a slight polish.

-- Artifact 125-88 (Figure 78b) is the mid-shaft portion of a bison right radius. It is a spirally fractured fragment with a long oval-shaped surface reminiscent of a knife blade. A series of spall scars are located on the edge of the outer cortex along the medial surface. It is likely that this bone was used as a knife or fleshing tool.

-- Artifact 125-128 (Figure 78c), a portion of a large mammal extremity shaft, terminates in a spiral fracture bearing a thin, sharp edge. Flakes have been removed from this edge, both on the inner and outer cortex. It appears that this bone was utilized until its sharp edge dulled somewhat and was no longer suitable.

Figure 75. Awl-like bone artifacts.

(a) 99-1-8
(b) 100-489-11
(c) 99-311-1
(d) 100-222-3
(e) 118-104-2
(f) 101-131-161
(g) 100-400-37
(h) 101-183-12

a
b
c
d
e
f
g
h
1
2
3
4

Figure 75. Awl-like bone artifacts.

Figure 76. Spatulate bone artifacts.

(a) 100-222-4
(b) 101-326-8
(c) 99-167-22
(d) 100-311-12
(e) 100-400-21
(f) 100-400-28
(g) 101-220-15
(h) 125-185

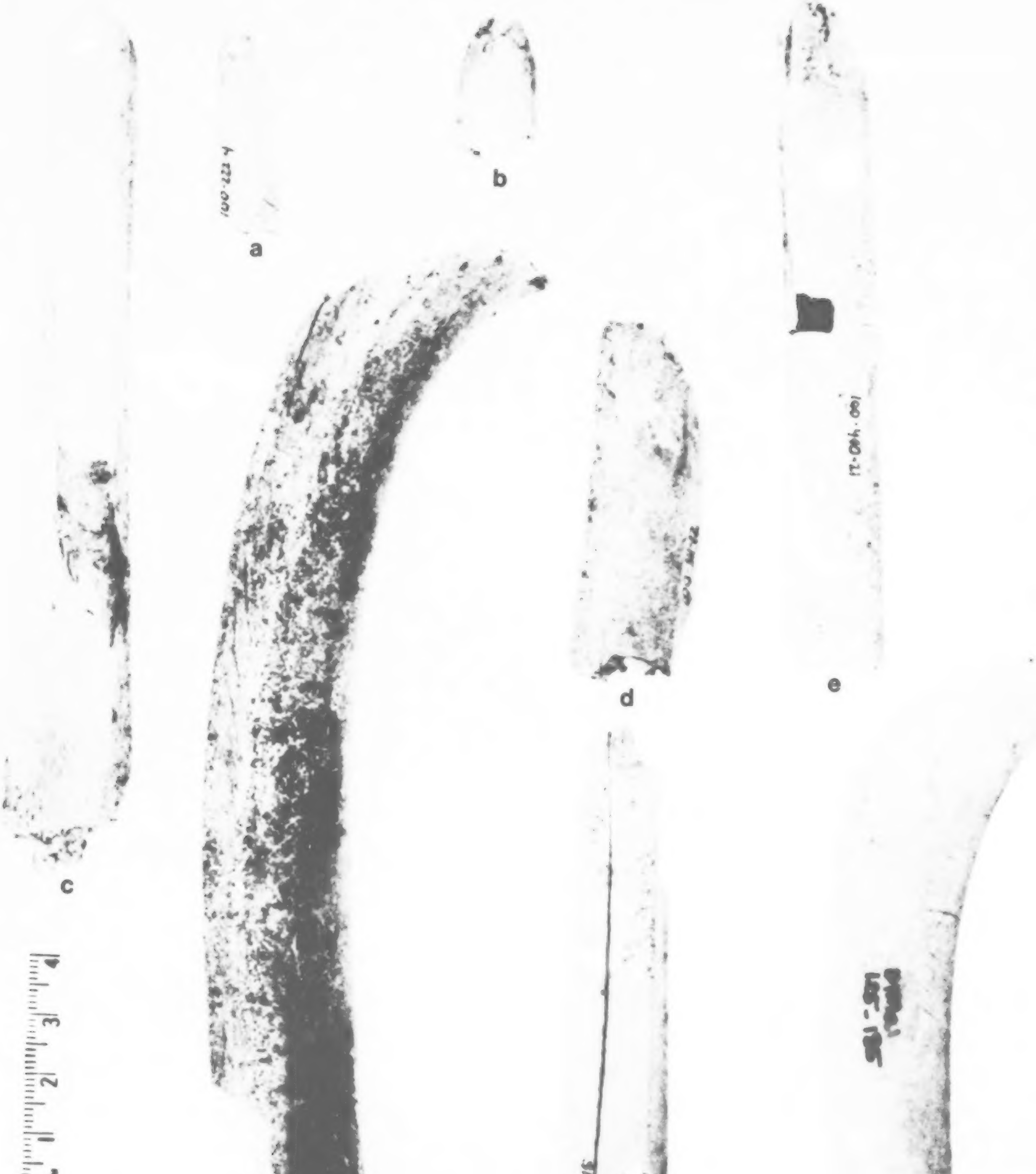
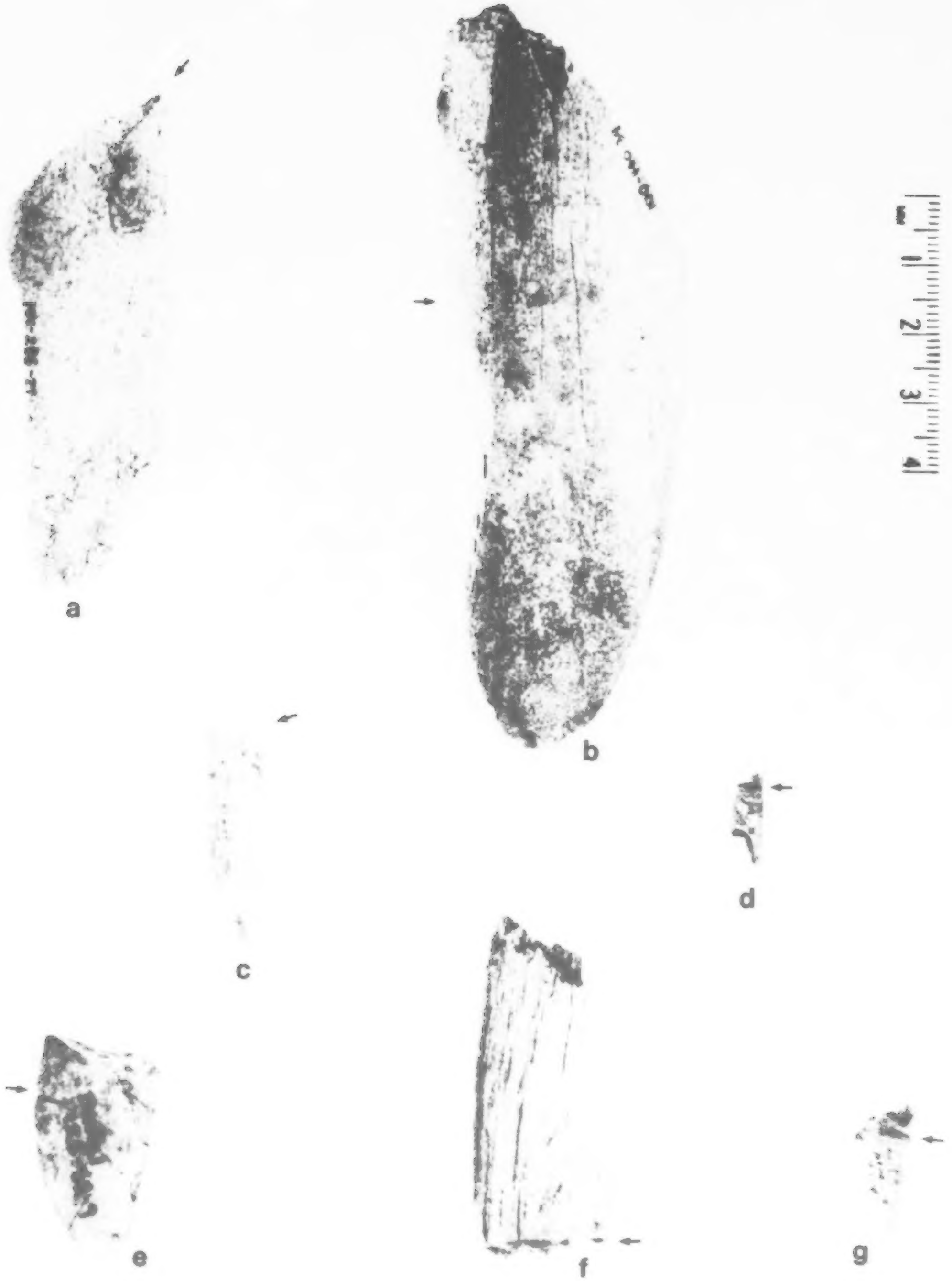

a
b
c
d
e
f
g
h
1
2
3

Figure 76. Spatulate bone artifacts.

Figure 77. Bone artifacts.

(a) 101-286-21
(b) 100-400-34
(c) 125-260-3
(d) 99-68
(e) 125-62-9
(f) 101-131-53
(g) 99-4



a
b
c
d
e
f
g
1
2
3
4

Figure 77. Bone artifacts.

Figure 78. Fleshing and butchering tools.

(a) 115-38
(b) 125-88
(c) 125-128
(d) 125-153
(e) 125-206-7

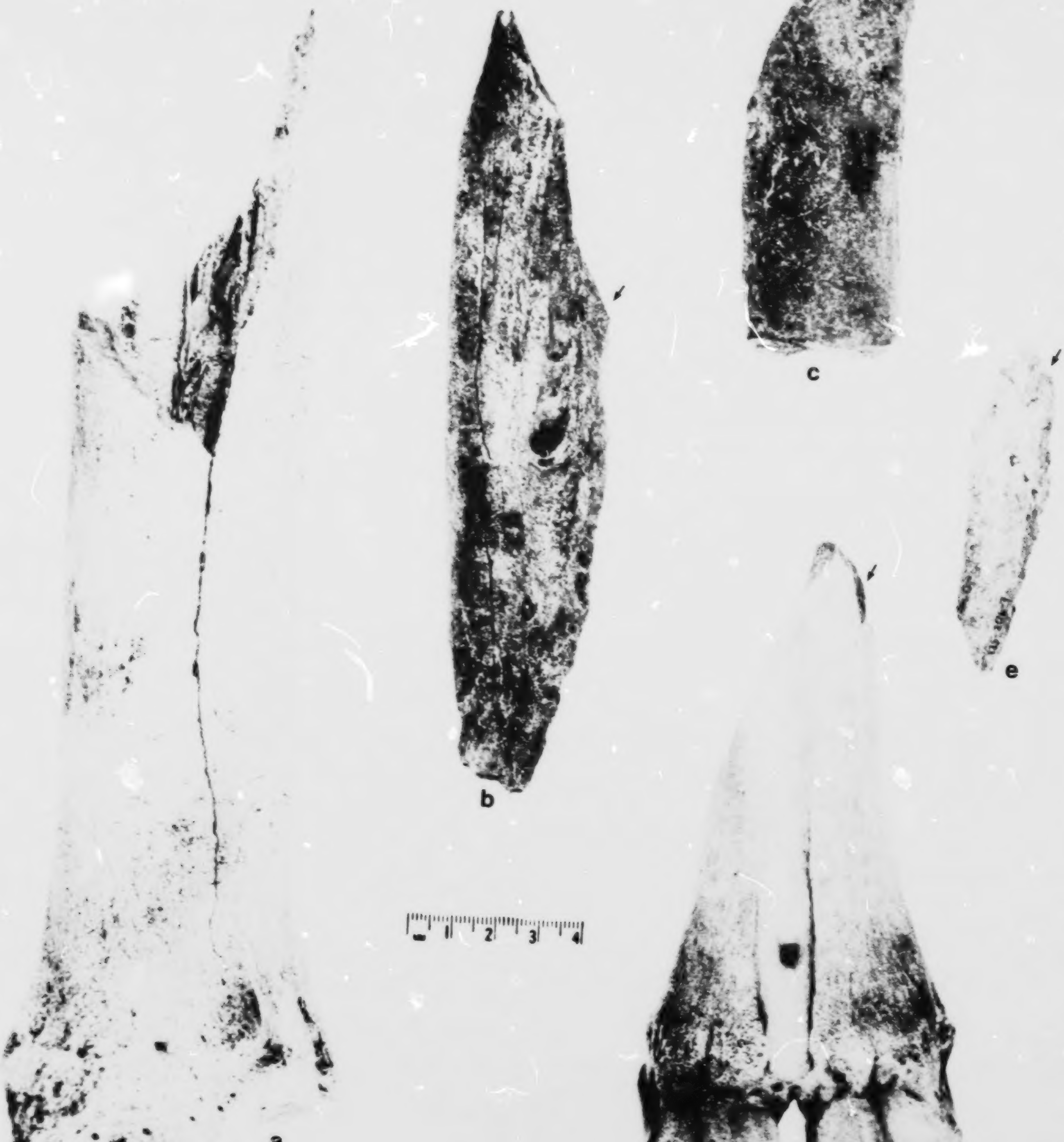


Figure 78. Fleshing and butchering tools.

-- Artifact 125-153 (Figure 78d) is a bison right distal metatarsal spirally fractured half way up the shaft. The proximal and medial edges are shattered, as if from hard use. The posterior and proximal surfaces both exhibit signs of wear and polish.

-- Artifact 125-206-7 (Figure 78e), the ulna of a large artiodactyl, is a mid-shaft fragment with some polish on the proximal end.

FEATURES

Bone Bed

With the exception of the burial mound, no doubt the most remarkable feature encountered during all investigations at DlMa-1 has been the thick accumulation of bone and associated artifacts. It was the discovery of this bone bed while digging a cellar foundation, that led Frank Stott to seek professional assistance in 1945 (Bird 1947:2). Despite his extensive prior experience, Richard S. MacNeish was somewhat taken aback by the magnitude of these faunal remains, when he opened excavations in Area G in 1952 (Figure 2).

> The digging of this L-shaped trench was somewhat governed by the circumstances and the advice of Dr. Bird, who had excavated in the area previously. The top humus, from 6 to 9 inches deep, which contained little cultural material, was removed by shovel and put through a half-inch mesh screen. Materials from this layer were sacked by square and called the top level. Below the humus was a compact layer of buffalo bone, with animal bone and artifacts between 6 to 14 inches thick. The bone was so compact that the first effort to remove it by trowel met with failure (MacNeish 1954:31).

Subsequent excavations throughout various areas within the site have confirmed the presence of this bone bed. Unfortunately, the discontinuous sampling strategy employed by most investigators to delineate areal boundaries has helped to promote the notion that the bone bed underlies the site more or less continuously. Once the assumption of a uniform distribution of the bone bed has been made, it becomes quite simple to also assume cultural uniformity, i.e., Blackduck.

In fact, distribution of the bone bed is quite variable both within and between areas of the site. One of the Field School units in Area G in 1975 contained the "leading edge" of the bone bed. Half of the unit held a thick layer of bone; the other half contained scarcely any bone at all (Leigh Syms: Personal Communication). During the initial investigations in Grand Valley Provincial Recreation Park in 1977, Tisdale excavated some units that were literally sterile (Tisdale 1978:49). Excavations on both sides of the TransCanada Highway in 1982 revealed considerable variability in Areas F and Upper B, as well. In Area F (Figure 8), three of the seven units excavated, 102-104, contained small amounts of bone but certainly no bone bed, despite the fact that they were positioned only 20 m east of the extremely prolific units, 99-101 (Figure 79). In Area Upper B (Figure 9), Units 105-110 proved to be virtually without artifactual materials and the bone bed in the remaining 14 units, 111-124, did not compare favourably in terms of thickness with that located in Area F (Figure 80).

Each of the persons involved with various aspects of this report has had his or her own particular interest in the location and distribution of the bone bed. For the faunal analyst, the bone bed in large part comprises the subject matter of analysis. For those interested in artifact recoveries, the bone bed conveniently marks location, e.g. this item was retrieved above, within or below the bone bed. In order to insure that those involved were discussing the same phenomenon, however, it became apparent that the bone bed must be defined on the basis of objective criteria. Two such possibilities

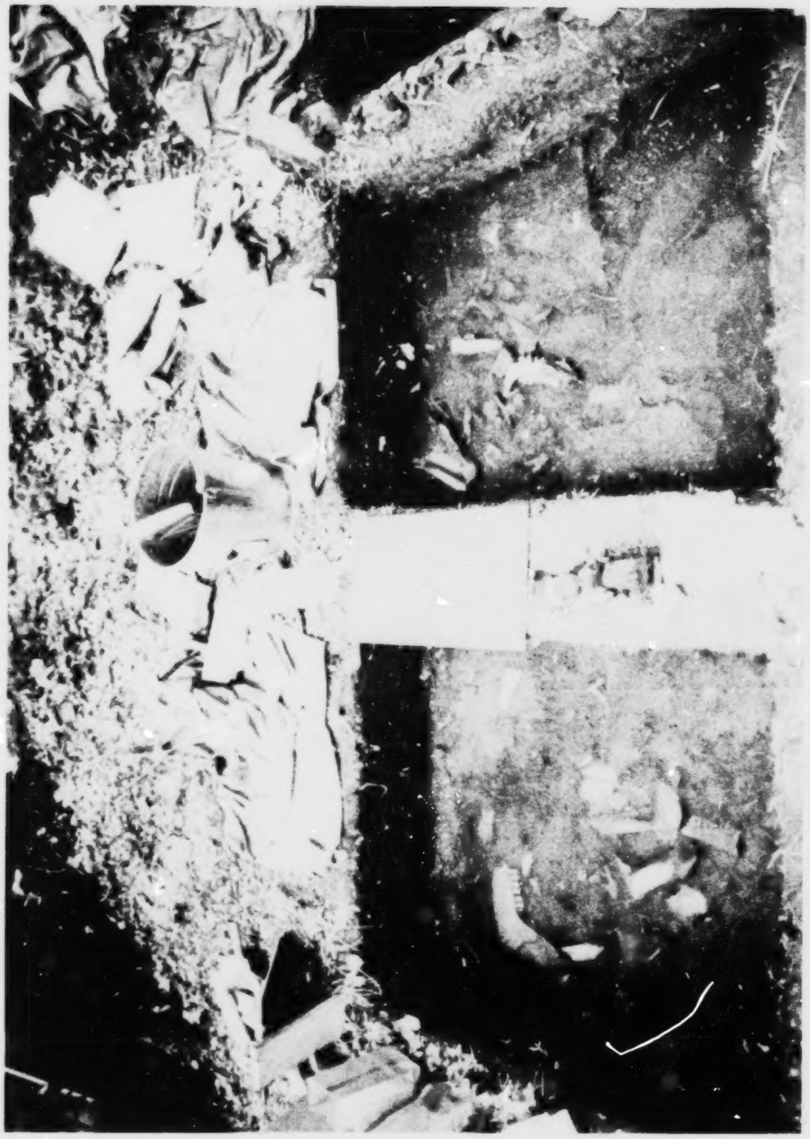


Figure 79. Top of the bone bed in Units 99 and 100 at 25 cm DBS.

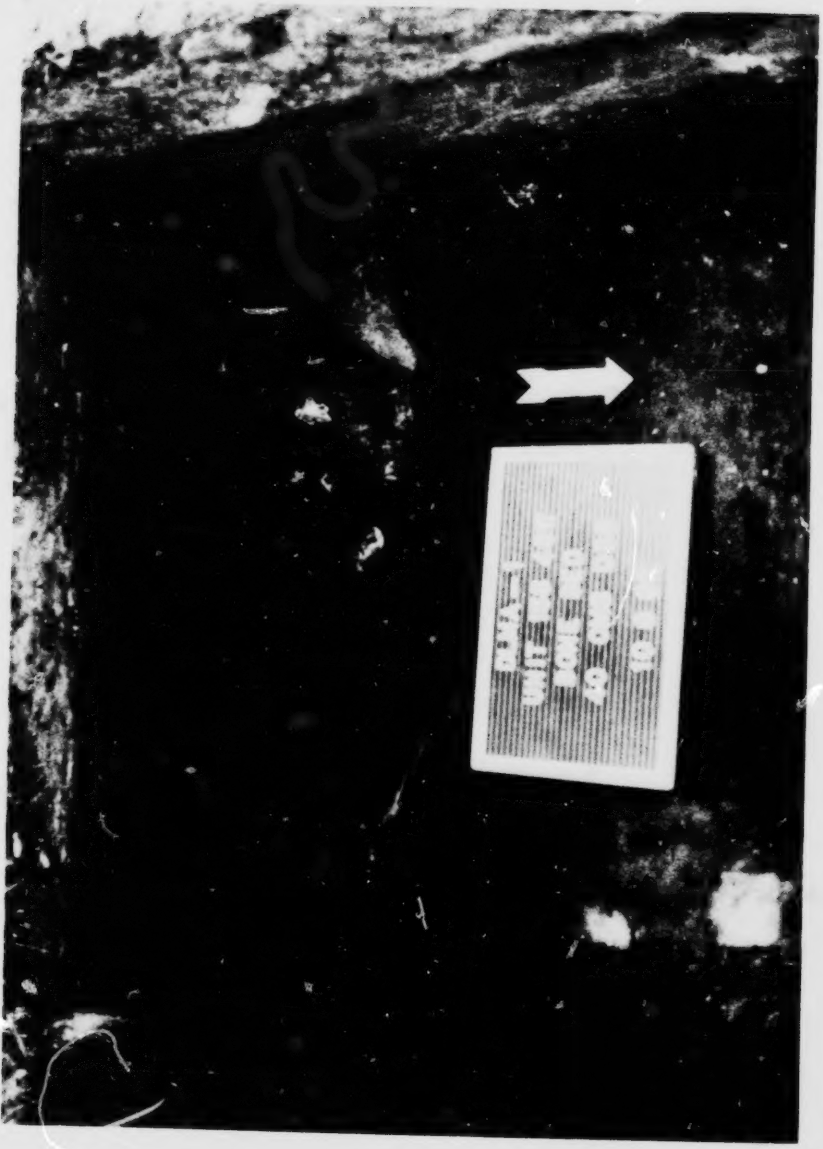


Figure 80. Bone bed in Unit 118 at 40 cm DBS.

seemed obvious -- pieces of bone per level or weight of bone per level. Interestingly enough, when these two measures were plotted for the units involved, they did not always coincide. The location of the bone bed in individual or groups of units is displayed in Table 52. The levels of concentration were determined by weight, while the upper and lower limits of the bone bed were calculated on the basis of either number of pieces or weight. In cases where piece and weight totals could not be reconciled, weight was given precedence.

The observed variation in distribution of the bone bed throughout Areas F and Upper B likely indicates in part, occupation of the site by bison-utilizing peoples at chronologically different times. Radiocarbon dates obtained on bone recovered in 1977 from Grand Valley Provincial Park confirm this interpretation (Tisdale 1978:100). In his analysis of recoveries from the Olsen-Chubbuck and Jurgens Sites (1978:84-89), Wheat distinguished four types of bone bed and associated cultural materials as indicators of differing activities.

-- At the mass-kill site, one finds evidence of a natural or artificial trap and possibly remnants of a drive pathway. Artifacts consist primarily of projectile points and/or knives utilized in the killing and initial butchering of the animals. The bone bed is highly concentrated, consisting almost entirely of a single species of animal. Skeletal elements demonstrate a high percentage of bone that is heavy in proportion to the amount of meat it offers, e.g., the skull. Articulated skeletons of whole or partially whole animals are common and many individual bones remain intact.

TABLE 52

LOCATION OF THE BONE BED

UNIT	CO-ORDINATES	LEVELS	RANGE (CM)	CONCENTRATION	
				LEVELS	RANGE (CM)
Area F					
99	ON 104E	3-7	10-35	6	25-30
100	ON 105E	4-7	15-35	6	25-30
101	ON 106E	5-8	20-40	6	25-30
125	8S 93E	3-7	20-45	3-4 6-7	20-30 35-45
Area Upper B					
111-116	4-9S 40W	8-10	35-50	10	45-50
117-118	15S 46-47W	7-9	30-45	8	35-40
119-124	46S 25-27W 47S 25-27W	7-9	30-45	Nil	Nil

-- At the butchering site, the bone bed exhibits differential distribution of specific elements. There are high percentages of front and rear leg sections present in comparison with the less "meaty" elements, e.g., the skull. No whole, articulated skeletons are present and few articulated elements. Many bones are broken and battered; few intact bones are found. Often high percentages of foot bones occur, indicating the removal of entire leg portions from the kill site to the processing area. No pound or trap is evident; the tools recovered indicate butchering activities.

-- At the long-term camp site, lasting possibly for several weeks, the bone bed resembles that of the butchering site with some major exceptions.

Bone of other animal species is recovered from the bone bed and most exhibit even greater breakage than at the butchering site. Artifacts include items indicative of general camp activities: tool sharpening or manufacture, bone working, hide working, etc.

-- At the short-term camp site, the bone bed is sparse indicating the killing of solitary animals rather than the communal destruction of many animals. Artifacts are also those of a general camp nature, but their numbers are not large.

When the 1982 recoveries from Areas F and Upper B are compared with Wheat's description, it is obvious that these remains indicate camp sites rather than kill or butchering areas. More specifically, it also appears likely that Area Upper B contains the remains of short-term camps, while Area F is the locus of more extended occupations.

Multiple Occupations

If one accepts the proposal that the cultural materials recovered at DlMa-1 represent the remains of an unspecified number of camp sites clustered in time around A.D. 800 and A.D. 1200 (Tisdale 1978:100), then considerable evidence should be available to demonstrate multiple occupations of the site. Radiocarbon dates support this contention, as well as horizontal differences in bone density and the distribution of particular ceramic and lithic artifact types. Vertical stratigraphy has always presented a problem for interpretation, however. Obviously the valley wall has eroded in the past and is actively eroding at present (see Figure 16).

Indeed, how much faith should one place in the vertical relationships of artifacts that lie either on the valley wall or on terraces at its base (see Chapter II)? Considering the amount and complexity of erosion that has occurred throughout the site, it is no wonder that assertions of multiple occupations have been muted.

Nevertheless, throughout the years, there have been indications of a more complex depositional history for the site than is generally assumed. While excavating in Area G in 1952, Richard S. MacNeish recognized three individual hearths in the bone bed.

> In digging the bone layer, three areas about two feet in diameter showed considerable burning and were considered to be hearths. One of these hearths was in the lower 3 inches of the bone layer with its centre near the easternmost end of the trench. A second hearth was in the lower one-third of the burnt area at E8 N1.5, whereas the other was on the top of [the] bone layer at E14. Artifacts were intermingled with the bone with no semblance of occupation layers or concentrations (MacNeish 1954:31).

Although MacNeish found it impossible to differentiate individual occupations visually, he did consider the hearths likely evidence of multiple occupations of the site.

> Fire-pits in, above, and below the buffalo bones seem to indicate that there was more than just one buffalo "kill" and perhaps more than one occupation of the site. In fact, ... it seems probable that the site was not continuously occupied but, rather, was a summer or winter camp occupied intermittently by the same group over a considerable length of time (MacNeish 1954:50).

In addition to the recovery of Blackduck materials clustering at the A.D. 800 and A.D. 1200 time periods, Tisdale's work in Grand Valley Provincial Recreation Park in 1977 also suggested the presence of early Historic and late Archaic components in Area A (1978:43). During the 1979 Field School, Syms looked specifically for such evidence.

> Despite the fact that all units were taken to 100 cm. below surface, no evidence of an earlier archaic layer was found, as in Area A in the Park where a stone alignment and a pooled date of 926 B.C. ± 111 were obtained (Tisdale 1978).

> There was, however, evidence for a Blackduck occupation just under the bone bed. In XU64, a hearth was carefully excavated and appeared to have been separated from the bone bed by a couple of centimeters of soil. Other units produced charcoal in the soil under the bone bed. I noticed the same pattern in one of the 1975 excavation units. It would appear that there had been a major fire across the site just before the bone bed was laid down and that there was an occupation (Syms et al. 1979:129; 131).

Hamilton's work in Area F after the Field School also produced evidence for multiple occupations. Unit 75 held two hearths at depths of 55 and 60 cm DBS, while Unit 78 contained three hearths at depths of 40, 55 and 80 cm DBS (1981:47-51). Although Hamilton proposed as many as 19 individual occupations within six excavation units at the western end of Area F (1981:57-70), some of which coincide with the hearth features in Units 75 and 78, it is quite likely that the majority of these occupations are more apparent than real. Because the depositional material within which the artifacts are found is reworked, i.e., originating elsewhere and moving downslope by a variety of erosional mechanisms (see Chapter II), the vertical association of artifacts with each other and such features as hearths is highly suspect.

These reservations are not meant to discredit prior assertions of multiple occupations at DlMa-1. On the contrary, multiple occupations most certainly did occur. The difficulty arises with attempts to group cultural materials together with certainty when they occur on a landscape that has been eroding for thousands of years. A good example of the sorts of difficulties encountered can be seen in the "trench", Units 99-101, which were the first to be excavated in Area F in 1982. Beneath the bone bed and angling downward from west to east were three buried Ah horizons alternating with buried Ck horizons in layer cake fashion (Figure 81). Initial interpretation of their

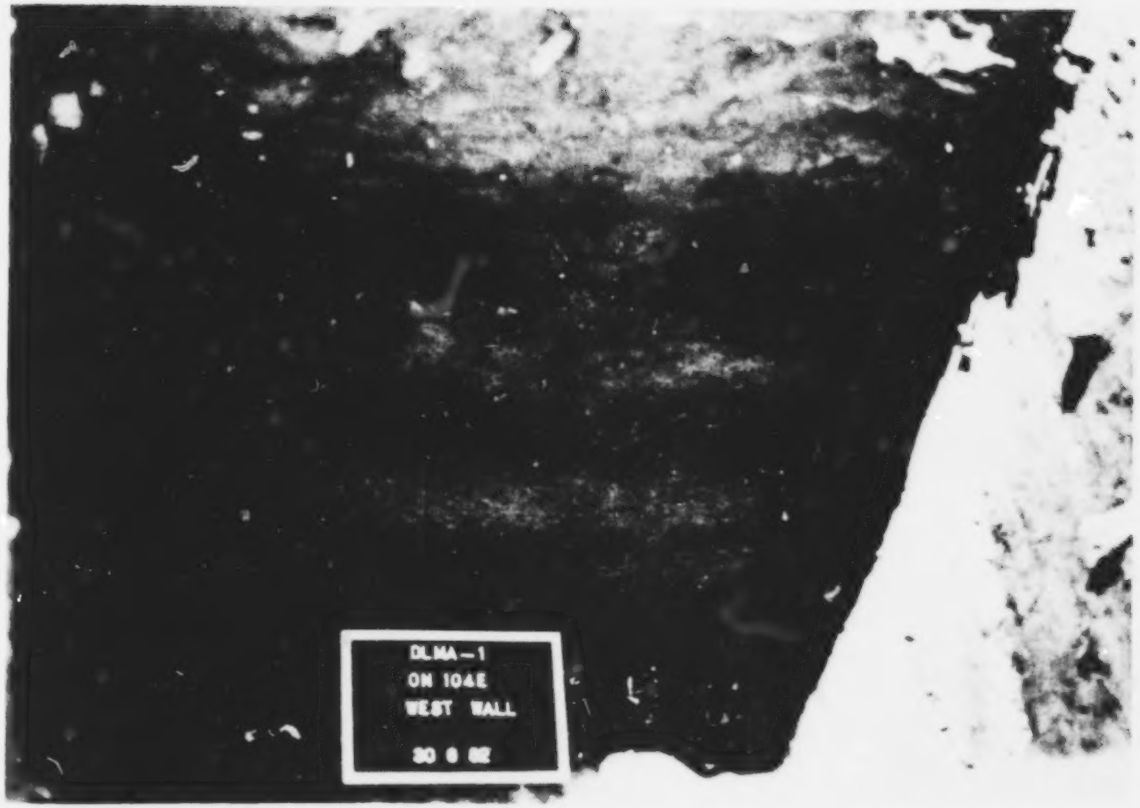

DLMA-1
ON 104E
WEST WALL
30 6 82

Figure 81. Buried soil horizons in Unit 99.

presence was that confirmation of early pre-bone bed and possibly pre-Blackduck occupations had been discovered. Some few cultural materials were recovered from the IAhb and the IIAhb horizons, including a Mode VI rim, Knife River Flint flakes and fish bone, as well as small fragments of unidentifiable large mammal bone. As well, a thin (5-10 cm) layer of decayed bone appeared at the bottom of the IAhb horizon in Unit 99 (Figure 82). This deposit of decayed bone did not continue into the adjacent Unit 100 and subsequent laboratory analyses (see Chapter II) revealed that these buried horizons resulted from localized (these horizons do not appear eight metres south in Unit 125) flows of depositional materials originating on the valley wall, thus rendering problematic the context of the artifacts within these horizons. Are the Knife River Flint flakes truly associated with the Mode VI rim, or were they "picked up" as the soil matrix of IIAhb moved down the hill?

Despite the severe restrictions imposed by the effects of erosion, relatively unambiguous evidence of at least two occupations was discovered in Unit 125, which lay 8 m south and 12 m west of the three "trench" units. In her analysis of the faunal recoveries, Roberts suggests the possibility of two "thin" bone beds in Unit 125 (see Chapter III; also Table 52), but a mere 5 cm separation between them seemed suspicious. Roberts' assessment was based upon both count and weight of bone from this unit and is corroborated by the distribution of lithic debitage throughout the unit (Table 53). During the excavation of Unit 125 by Michael Zywina, an obvious difference in the amount of bone recovered was noted between Levels 5 and 6. This second deposition of large, identifiable bone in Level 6 was recognized as unusual and a photograph requested (Zywina, Field Notes Unit 125, August 16, 1982; Figure 83).

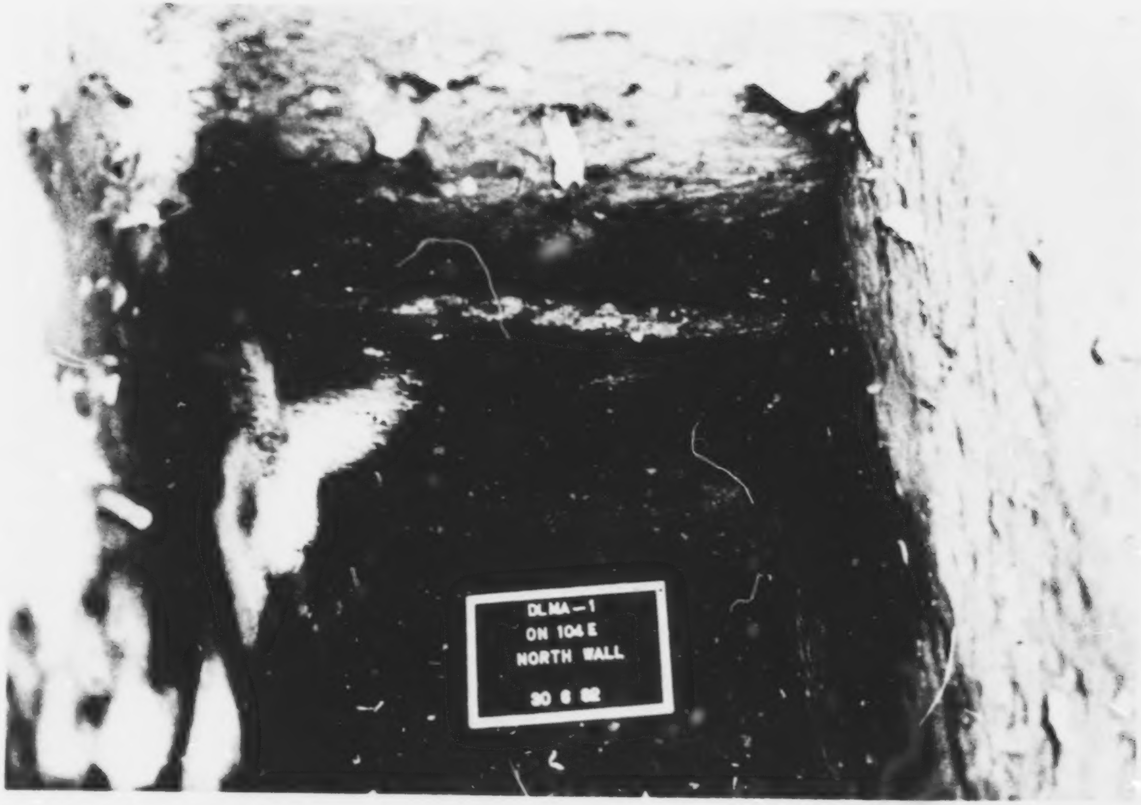

DLMA—1
ON 104 E
NORTH WALL
30 6 82

Figure 82. Layer of decayed bone on north wall of Unit 99.

TABLE 53

DISTRIBUTION OF BONE AND LITHIC DEBITAGE BY LEVEL IN UNIT 125

LEVEL	DEPTH BELOW SURFACE	PIECES OF BONE	WEIGHT OF BONE (G)	LITHIC DEBITAGE
1[a]	(0-15 cm)	3431	1836.9	119
2	(15-20 cm)	990	815.1	28
3	(20-25 cm)	1068	1034.5	36
4	(25-30 cm)	1374	1368.9	39
5	(30-35 cm)	367	507.4	8
6	(35-40 cm)	663	1368.9	22
7	(40-45 cm)	509	1502.3	18
8	(45-50 cm)	173	170.5	4
9	(50-55 cm)	140	139.8	0
10	(55-60 cm)	26	16.7	2

[a] In order to even the floor of the unit, it was necessary to excavate a 15 cm first level; other levels were 5 cm in depth. The measures given for Level 1 in the table should be divided by 3 in order to obtain an average figure for a 5 cm depth.

Unfortunately, no diagnostic artifacts were associated with either of these bone beds. Ceramically, Levels 3 and 4 contained 36 bodysherds, 1 necksherd and 6 decorated bodysherds; Levels 6 and 7 held only 14 bodysherds. The recovery of lithic artifacts was no more helpful. Levels 3 and 4 produced 2 cores, 2 rough unifaces and 1 utilized flake. Levels 6 and 7 held 1 core, 2 rough unifaces, 1 rough biface and 1 fine uniface. The three Blackduck vessels recovered from this unit were located in Level 1 at depths of 13 and

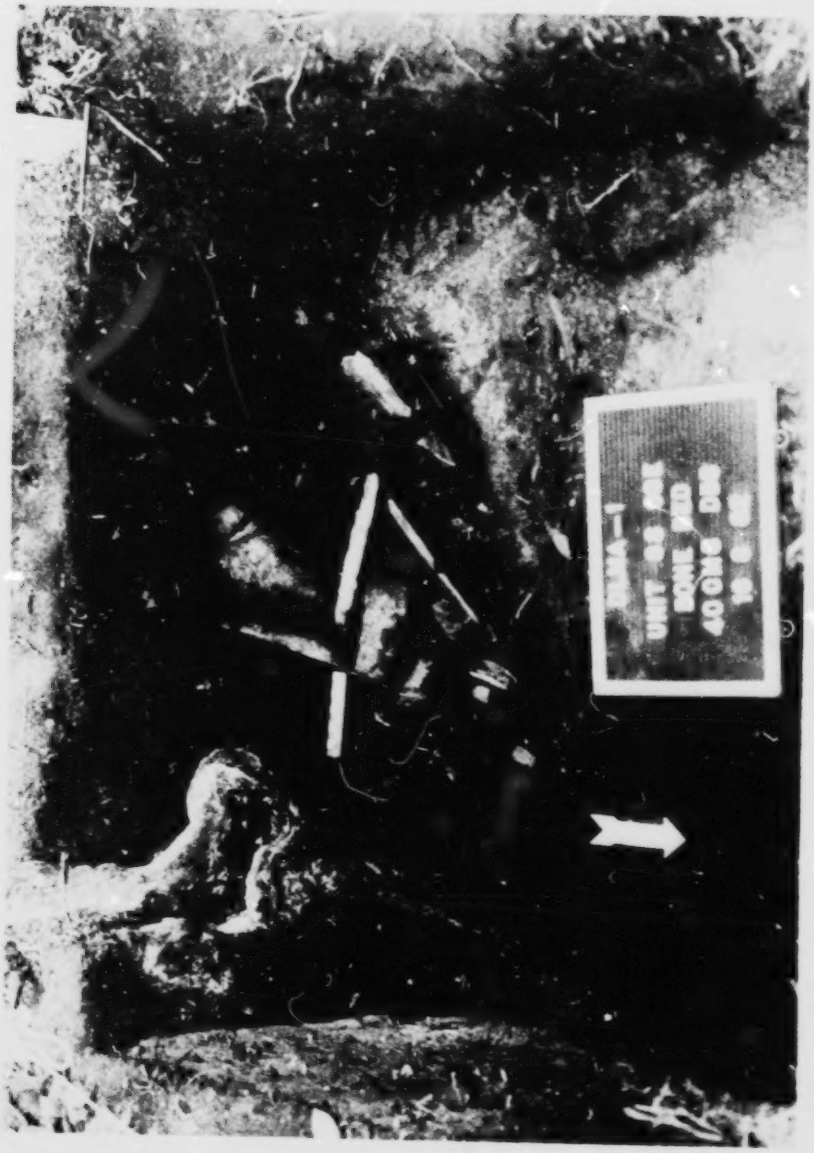


Figure 83. Unit 125 - floor of level 6 at 40 cm DBS.

15 cm DBS, at least 5 cm higher stratigraphically than the upper of the two bone beds. Because the soil in this unit is essentially the same reworked material on all levels containing artifacts (see Chapter II), it is hazardous to even attempt an estimate of how much time might have separated the two bone beds. Conceivably the 5 cm of soil between the two occupations could have been laid down in a very short time. Certainly the artifacts associated with the two bone beds appear similar; the only apparent difference is that the upper bone bed contains more cultural material than the lower.

Bison bone from the second bone bed was utilized for radiocarbon assessment. Specimen 125-288, the distal end of a right humerus recovered at a depth of 43 cm DBS, was sent to the Saskatchewan Research Council in Saskatoon for radiocarbon dating. A date of 1040 ± 90 years BP (A.D. 910 ± 90) was obtained on this specimen (S-2318), designating the lower bone bed in Unit 125 as "Early Blackduck". This finding is certainly not inconsistent with the two dates recovered from the base of the bone bed in Area G, A.D. 840 ± 60 (S-1272) and A.D. 910 ± 45 (S-1273) and, in fact, the latter date is nearly identical with the 1982 assessment.

Because there is no way of knowing how much time separated the deposition of the two bone beds in Unit 125, in retrospect it also would have been useful to date bone from the upper bed as well. Although no diagnostic materials were present in either bed, there were three ceramic vessels (Vessels 43, 44 and 45) present in Level 1 of the unit (0 - 15 cm DBS). Two of the three vessels, 43 and 45, are considered representative of "Early Blackduck" as defined by Lugenbeal for the Smith Site. Since these vessels were recovered stratigraphically higher than both the upper and lower bone beds in Unit 125, it would be logical to assume that the upper bone bed is also "Early Blackduck". However, because there were virtually no direct correlations between Smith Site and Stott Site Blackduck vessels, it may be that the apparent similarities are, in fact, not significant. Additionally, there is also the ever present problem of erosion, which renders suspect any conclusion based on vertical stratigraphy. Therefore, it is necessary to be content with only suggesting that the upper bone bed in Unit 125 is also "Early Blackduck".

Hearths

In contrast with previous investigations at DlMa-1 (Table 54), there were no unambiguous hearth features discovered during the 1982 excavations. Certainly in Area F the three trench units, 99-100, contained numerous fragments of burned bone and flecks of charcoal; however, no localized and well-defined areas of ash associated with charcoal, burned bone or fire-cracked rock were apparent. Each of the three units, plus the balk between Units 100 and 101, did contain within the bone bed small patches of stained soil ranging between 10 and 15 cm in thickness, but whether these constituted hearths was not determined. In Area Upper B, Units 117 and 118 bordered on the southern edge of Unit 87 which was excavated during the 1981 field season. Despite the fact that Unit 87 contained a hearth in its southwestern quadrant, no evidence of it was found in either Unit 117 or 118.

Vertical Bone

Although three of the units in Area F, 102-104 (Figure 8), produced few artifacts and no bone bed, Unit 102 did contain two features that consisted of bison bone positioned vertically within V-shaped pits. Feature 1

TABLE 54

HEARTH FEATURES AT DlMa-1

AREA	LOCATION	SPECIFICS	REFERENCE
A	Unit 15	Charcoal	Tisdale 1978:60
	Unit 16	Ash	Tisdale 1978:60
	Unit 17	Charcoal	Tisdale 1978:61
Upper B	Unit 87	Burned soil	Pokotylo and Tisdale 1982
	Unit 90	Oxidized soil; bones	Pokotylo and Tisdale 1982
Lower B	Unit 53	Charcoal	Tisdale 1978:72
	Unit 94	Ash; bone; oxidized soil	Pokotylo and Tisdale 1982
	Unit 98	Ash	Pokotylo and Tisdale 1982
F	Unit 58	Charred bone; fire-cracked rock	Syms *et al*. 1979:102
	Unit 64	Ash; charcoal; burned bone; fire-cracked rock	Syms *et al*. 1979:81
	Unit 75	1) Red stain; burned bone	Hamilton 1981:47
		2) Red stain; charcoal	Hamilton 1981:47
	Unit 78	1) Ash; red stain; burned bone	Hamilton 1981:47
		2) Ash; red stain; burned bone	Hamilton 1981:51
		3) Ash; red stain; charcoal	Hamilton 1981:51
	Unit 79	Ash; burned bone	Hamilton 1981:47
G	Trench	3 areas of "considerable burning"	MacNeish 1954:31

was recognized initially on Level 8, when it was noted that "there is a scapula (from large mammal) embedded vertically in the floor of this level in the SE corner (Bradford, Field Notes Unit 102, June 15, 1982)." When the bone was removed, it was found to be a single left bison scapula broken in such a manner that the spine was removed as well as the medial portion of the body. About one-third of the lateral part of the body remained, while the posterior border was broken at the neck. The glenoid cavity, which stood upright in the unit and was revealed first during excavation, was stained a rusty red-brown colour; it showed no evidence of having been pounded or impacted. Additionally, the dorsal surface of the scapula was covered with thick black spots. The scapula extended from 38 - 55 cm DBS and was removed on Level 11 (Figure 84). The pit containing the scapula did not become obvious until Level 10 at 46 cm DBS; it continued to a depth of 68 cm, 13 cm deeper than the scapula, but its circumference diminished steadily with increasing depth. The soil within the pit was darker and of a softer texture than that of the surrounding matrix. No artifacts were associated with the feature, although flecks of charcoal were scattered throughout the pit fill.

During the excavation of Unit 102, Feature 2 was revealed only as a right radius and rib fragments protruding from the east wall (Figure 84). The uppermost portion of these bones appeared first on Level 6 at a depth of 25 - 30 cm DBS. Once it was decided to remove these bones, a 30 cm eastward extension of the unit was staked out and excavated as before. Figure 85 shows Feature 2 near the bottom of Level 6 at a depth of 28 cm DBS. In addition to the pit within which the bones were found, the

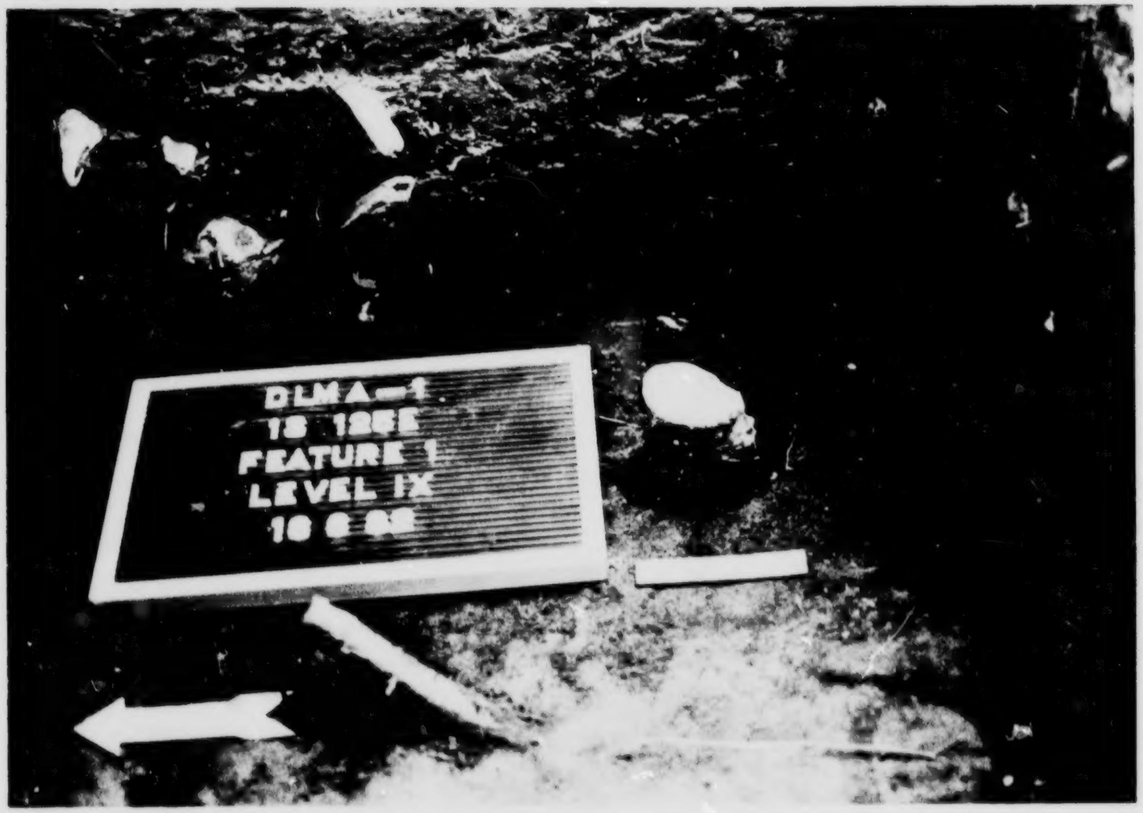

DLMA-1
1S 125E
FEATURE 1
LEVEL IX
16 6 88

Figure 84. Feature 1 in Unit 102 on level 9.

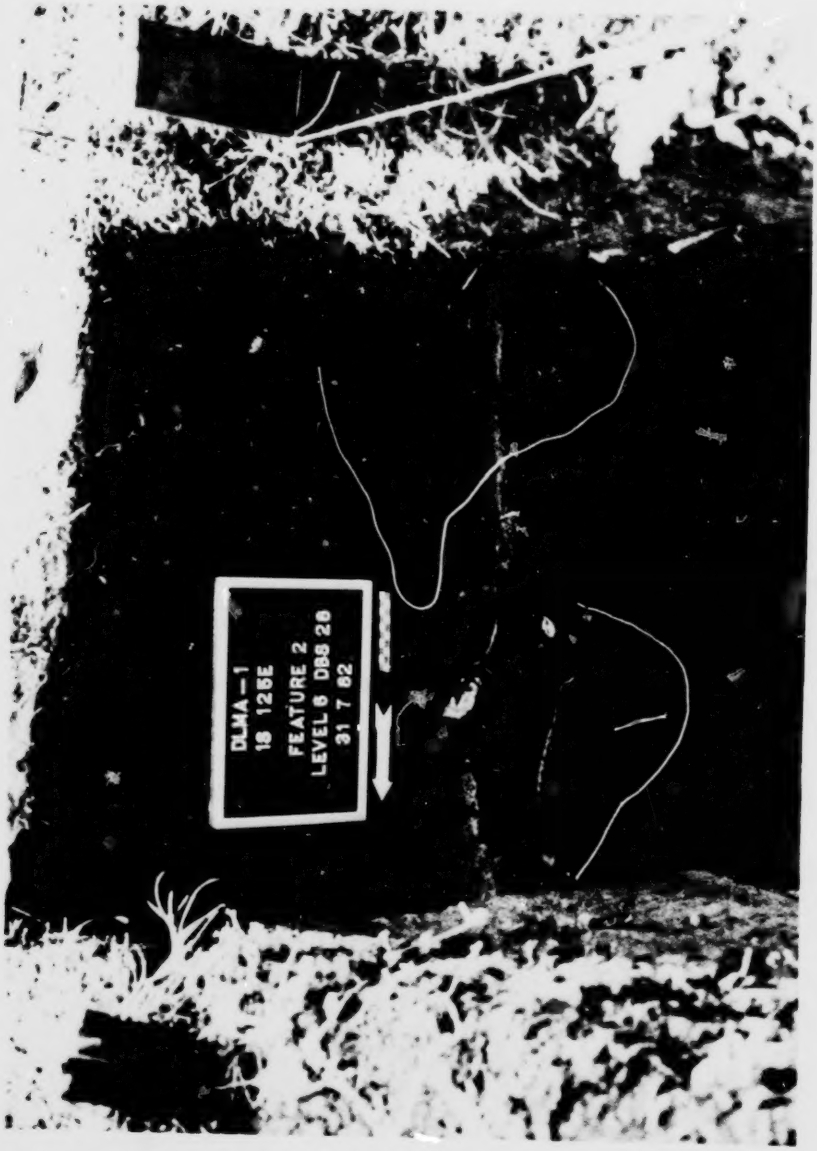

DLMA—1
1S 125E
FEATURE 2
LEVEL 6 DBS 20
31 7 82

Figure 85. Feature 2 in Unit 102 on level 6.

> ... shallow outline of a pit-like feature was uncovered. It was composed of soft, dark black silt containing little artifactual or faunal material. It appeared at DBS 20-25 cm and essentially disappeared by DBS 50 cm. It was only clearly oulined at DBS 25 cm; after that it was vague. I suspect that this is back-dirt from one of the pits [Feature 1 or 2] (Bradford, Field Notes Unit 102, August 10, 1982).

Both Feature 2 and the adjacent shallow pit are outlined with string in Figure 85.

Feature 2 was comprised of a group of nearly vertical bison bones placed in a V-shaped pit and found 30 - 66 cm below present ground surface. Five of the six bison extremity shafts were right-sided. All were incomplete and the group consisted of a distal radius, proximal ulna, distal metacarpal, distal tibia and proximal metatarsal; a right fibular tarsal was also present in the centre of this group. The left-sided bison extremity shaft was a proximal metatarsal. Two additional elements were ribs from medium to large-sized mammals. These bones were wedged tightly together, with the proximal ulna lying horizontally across the proximal ends of the right metacarpal and right metatarsal (Figure 86). All of the long bones were spirally fractured and found with their fractured ends placed downward. Like Feature 1's scapula, they were also heavily spotted, a condition probably caused by the wet soil surrounding them. All of the exterior surfaces appeared to be rotting. It was noted that an area of wear had been created between the tibia and one of the ribs. Apparently the bones were packed so tightly together that they had naturally abraded one another. Small cut marks were observed above the abrasion on each bone. The pattern of the cuts is similar for each bone, but they do not appear to have resulted from butchering activities.

Although some artifactual material was recovered from the 30 cm extension of Unit 102 designated as Feature 2, none was directly associated with the vertical bison bones or the pit containing them. Two projectile point fragments were recovered from Levels 1 and 2, as well as a Mode Ia Blackduck rimsherd (102-145) from Level 3. These, however, were located well above the pit feature and also south of it. On the same levels as the feature, a decorated body sherd and two rough unifaces were found, but again, these were not associated with the bones or the pit.

The distal end of the bison right radius in Feature 2, specimen 102-182 (Figure 86), was also sent to the Saskatchewan Research Council in order to obtain a date for the vertical bone feature. This date was calculated at 1050 ± 95 years BP, or A.D. 900 ± 95 (S-2319), which overlaps nicely with the date from Unit 125, A.D. 910 ± 90 (S-2318) and the two dates from Area G, A.D. 840 ± 60 (S-1272) and A.D. 910 ± 45 (S-1273). Unfortunately, diagnostic artifacts were not plentiful in this unit, with the only two vessels recovered occurring well above the pit feature stratigraphically. Vessel 46, 102-19, recovered at a depth of 5 cm, has not been classified. Although bearing an oblique/horizontal exterior decorative motif indicative of Blackduck ceramics, the design is executed with incised lines, the vessel surface is uncharacteristically smoothed, and the overall profile is not that of a Blackduck pot. Vessel 47, 102-145, found at a depth of 14 cm, was classified as Mode IA, which fits within Lugenbeal's "Early Blackduck" grouping and is consistent with the radiocarbon date of Feature 2.

Equally as intriguing as the presence of two bone-filled pit features in Unit 102 is the occurrence of similar features in units excavated further west in Area F in 1979. Two such features appeared in Unit 60 located several

Figure 86. Diagram of Feature 2.

Key:
1. Distal end right radius with ulna 102-182*
2. Distal end right metacarpal 102-178
3. Rib fragment 102-186
4. Rib fragment 102-162
5. Proximal end left metatarsal 102-154
6. Proximal end right ulna, capping #s 2 and 7, 102-166
7. Proximal end right metatarsal 102-174
8. Distal end right tibia 102-185
9. Right fibular tarsal 102-177

*Used for radiocarbon assessment.

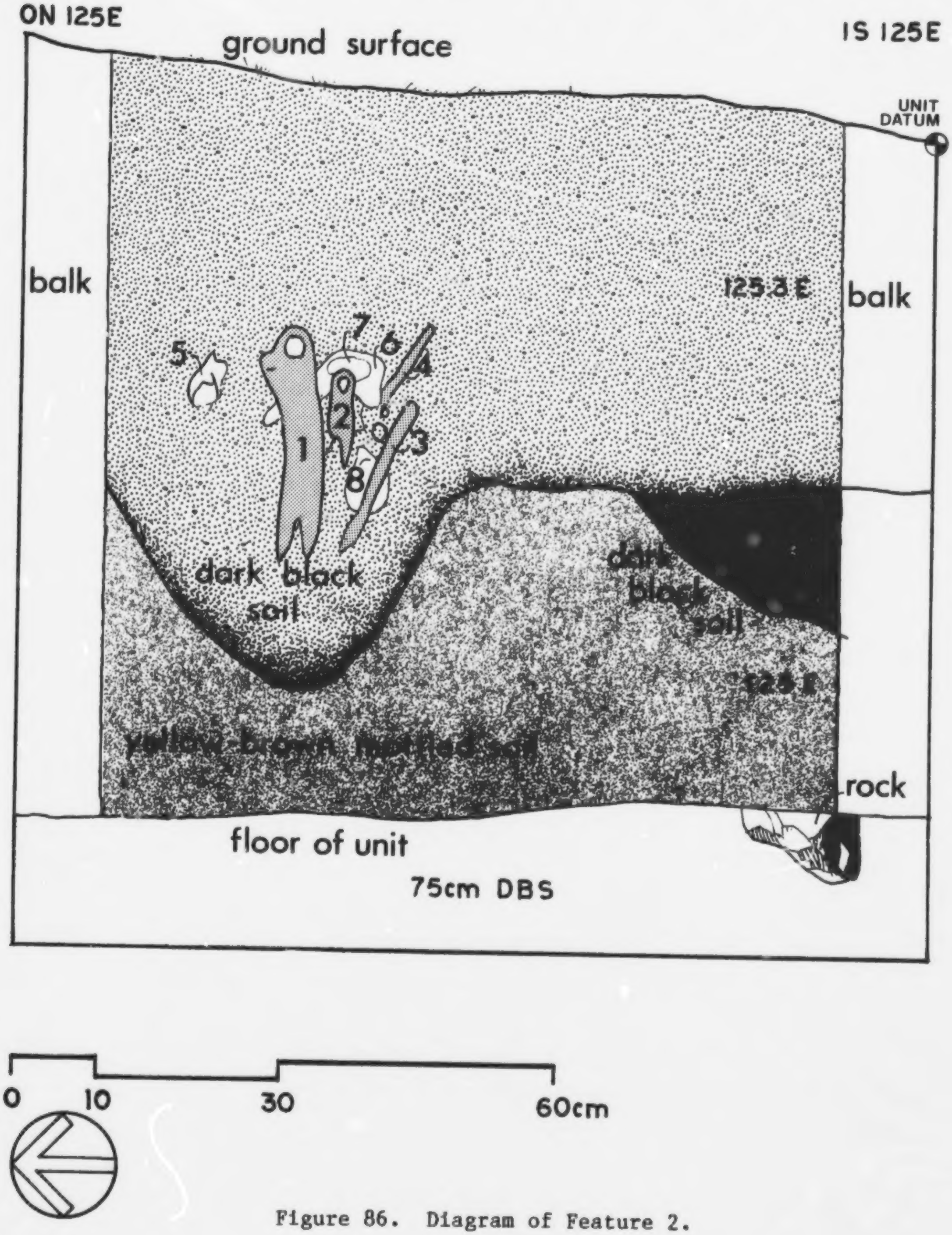

ON 125E
ground surface
IS 125E
UNIT DATUM
balk
125.3 E
balk
5
7
6
4
2
1
3
8
dark black soil
dark black soil
125 E
yellow brown mottled soil
rock
floor of unit
75cm DBS
0
10
30
60cm

Figure 86. Diagram of Feature 2.

metres uphill and west of the 1982 "trench" units, 99-101 (Figure 8). Here a "clay patch" appeared on Level 3 (21-30 cm DBS) and continued until 54 cm DBS.

> At 41/43 cm the clay patch became roughly circular in shape. A rib stuck out vertically from the ground at the east edge of the disturbance. To the south of the patch other linear bones laid at angles to the ground (Charette in Syms et al. 1979:53).

This "clay patch" with its vertical bone was originally attributed to burrowing rodents, but analysis of the distribution of artifacts within the unit revealed that the western half of the unit in which the vertical bone had been found contained five times as much cultural material as the eastern half. Furthermore, when a stratigraphy trench was dug along the eastern wall of the unit, two vertical bison scapulae were found embedded in the wall. This latter feature was removed in its entirety later during the field season by Hamilton (1981:45), who found that it consisted of three bison scapulae and one mandible oriented vertically within a faintly discernible pit. The tops of these bones coincided with the beginning of the bone bed in this unit at a depth of 35 cm DBS.

Unit 60 contained an interesting array of artifacts. Three of the four vessels recovered were not Blackduck. Vessels 60-2-65/60-3-44 and 60-4-32 were incised, while vessel 60-3-125 bore dentate stamps and triangular punctates. As well, three projectile points were retrieved representing three separate lithic traditions -- Avonlea Timber Ridge Sharp-Eared (60-3-32), Plains Paskapoo (60-4-71) and Prairie Side-Notched (60-7-9). Two Blackduck vessels (65-4-78 and 65-7-96) were retrieved from Unit 65 and two Prairie Side-Notched projectile points -- a Tompkins Side-Corner-Notched (65-9-52) and a Nanton Wide Rounded-Base (65-9-101).

Units 68 (17N 71E) and 70 (17N 64E), also excavated by Hamilton, contained analogous vertical bone features. Unit 68 lay at the eastern edge of the gully, directly opposite Unit 70 on the western side. In the former unit, a bison tibia and other long bone fragments were placed within a pit that began at 60 cm DBS and extended below the bone bed to 85 cm DBS (Hamilton 1981:45; 47). Four ceramic vessels were recovered from this unit, three of which fit within the general description of Blackduck. The fourth, 68-8-133, was decorated with cordwrapped object impressions and bosses. In the adjacent Unit 69, only one vessel was retrieved (69-3-43) and it was decorated with dentate stamps and bosses. Unit 68 held nine identifiable projectile points -- Irvine Narrow Square-Base specimens on Levels 7 and 11; Nanton Wide Rounded-Base specimens on Levels 2, 5 and 7, a NT 1 variety of the Plains Triangular type on Level 3 and three points of the NT 2 variety on Levels 2, 4 and 8. Units 69 had five identifiable points -- a Swift Current Fish-Tail point on Level 5, Irvine Narrow Square-Base specimens on Levels 3 and 6; a Nanton Wide Rounded-Base point on Level 2 and a NT 2 type Plains Triangular point also on Level 6.

The vertical bone feature in Unit 70 on the west side of the gully ranged from 37 - 70 cm DBS and also extended beneath the bone bed (Hamilton 1981:45). No discernible pit surrounded the three bison scapulae and one thoracic vertebra, which had been placed vertically into the ground with their proximal ends approximately level with the top of the bone bed. Five Blackduck vessels were recovered from Unit 70, as well as one Irvine Narrow Square-Base projectile point.

The relationship of the six vertical bone features to the bone bed is a most interesting subject. In Unit 102, of course, there was no bone bed and few artifacts. In addition to the one Blackduck vessel recovered from Feature 2, the only other diagnostic item from the unit was an unclassified vessel with an incised oblique over horizontal motif (102-19) found on Level 2, stratigraphically higher than the feature. In Unit 60 the bone bed was distributed from Levels 3 through 5, 21-50 cm DBS. The first feature there extended to a depth of 54 cm DBS. Unfortunately the depth of the second feature in Units 60/65 is not recorded. Both of the features in Units 68 and 70, however, are noted as extending beneath the bone bed (Hamilton 1981:45; 47). Given the available stratigraphic evidence, it seems logical to assert that these pit features likely predate the deposition of the bone bed in their respective units or, conversely, that all or part of the bone bed has eroded into position from an upslope location. Although several suggestions can be made regarding the use of these pits (see discussion following) none of the possible uses would involve digging a hole through an *in situ* layer of bone 20-25 cm thick, in order to implant additional pieces of bone vertically into the ground.

One is understandably tempted by the presence of several unclassified non-Blackduck ceramic vessels in units containing these vertical bone features to postulate an association between the two occurrences. It would be prudent to exercise a certain amount of caution here, however. Analyses of erosional factors affecting soil composition and deposition on the prairie level, valley wall and terraces (see Chapter II) indicate that little confidence can be placed in the stratigraphic relationships of cultural materials recovered in Area F. In her analysis of artifacts recovered from Unit 60, Charette considered erosional problems to be of minor significance.

> The soil profiles of the west, south and east walls show fairly continuous horizon boundaries. It was hypothesized that the slope wash was minimal, for test pit 62 situated at the top of the terraces yielded pebbles only. The artifacts found on the terraces were likely found in situ; they could not have been washed down from the upper field because this area contained no materials in the first place (Charette in Syms et al. 1979:53).

Yet the three projectile points recovered from Unit 60 were found in a stratigraphic relationship that is inconsistent with their accepted chronological placements (see Table 45). The Avonlea point occurred on Level 3 (21-30 cm DBS) and the Prairie Side-Notched point on Level 7 (61-70 cm DBS).

Further evidence supporting the contention that these vertical bone features predate deposition of the bone bed is found in Area Upper B in Unit 87, a 2 x 2 metre pit excavated in 1981, and the adjacent 1 x 1 metre Units 117 and 118 excavated in 1982 (Figure 9). On literally the last day of excavation in 1981, a vertical bone feature was found along the south wall of Unit 87.

> This is a bone-filled pit first defined in [the] floor of Level D8 (Subunit 14) as a dark smear surrounding [a] vertically oriented scapula and rib fragment (Tisdale, Field Notes Unit 87, August 22, 1981).

By the time this feature was uncovered, the bone bed in Unit 87 had already been removed. The hearth feature from Unit 87, which was also located in the southwest corner and concentrated on Levels D6 and D7, had occurred within the bone bed approximately 10 cm above the vertical bone feature. Confirmation of the relationship of this pit feature to the bone bed is demonstrated in Unit 117. The bone bed in this unit occurred on Levels 7 - 9, ranging from 30 - 45 cm DBS with a concentration at 35 - 40 cm DBS (Table 52). At approximately 60 cm DBS and extending to 75 cm DBS, one can observe on the north wall of Unit 117 the outline of a V-shaped pit directly opposite the location of the vertical bone feature in Unit 87 (Figure 87). Blackduck pottery and a Prairie Side-Notched projectile point were associated with the hearth, but no artifacts were found with the pit feature. A radiocarbon date on bison bone associated with the hearth resulted in a date of 1100 ± 150 years BP, or A.D. 850 ± 150 (SFU-229).

At least two Blackduck vessels were recovered from Unit 87. Portions of Vessel 3 were found in three separate units (86, 87 and 89); in Unit 87 sherds from this vessel ranged through five levels, one of which contained the bone specimen used for radiocarbon dating. This vessel was classed as Mode VI (Pokotylo and Tisdale 1982), which equates with the Smith Site Cluster 3 and is considered to be Late Blackduck. The second pot, Vessel 9, has been classed as Mode I (Pokotylo and Tisdale 1982). Parts of it, too, were found in several units (33, 34, 87, 88 and 89) and in Unit 87, one of its sherds was found on the level immediately above the bone used to obtain the C-14 date. This vessel would be considered Early Blackduck according to Lugenbeal's analysis. Although the vertical bone feature itself was not dated in Unit 87, on the basis of the radiocarbon date and the pottery styles, it does appear to be older than the bone specimen actually dated or either of the two Blackduck vessels.

To summarize, then, the seven vertical bone features recognized at the Stott Site commonly consist of one to several bison bones oriented vertically within V-shaped pits, which are located stratigraphically beneath the main bone bed. No artifacts can be identified as unambiguously associated with these features. A further similarity among the six features located in Area F is that all are positioned between an elevation of 399 and 400 m (Figure 8). The pit feature in Area Upper B, however, is found at an elevation of 376 m, some 24 metres lower than in Area F (Figure 9).

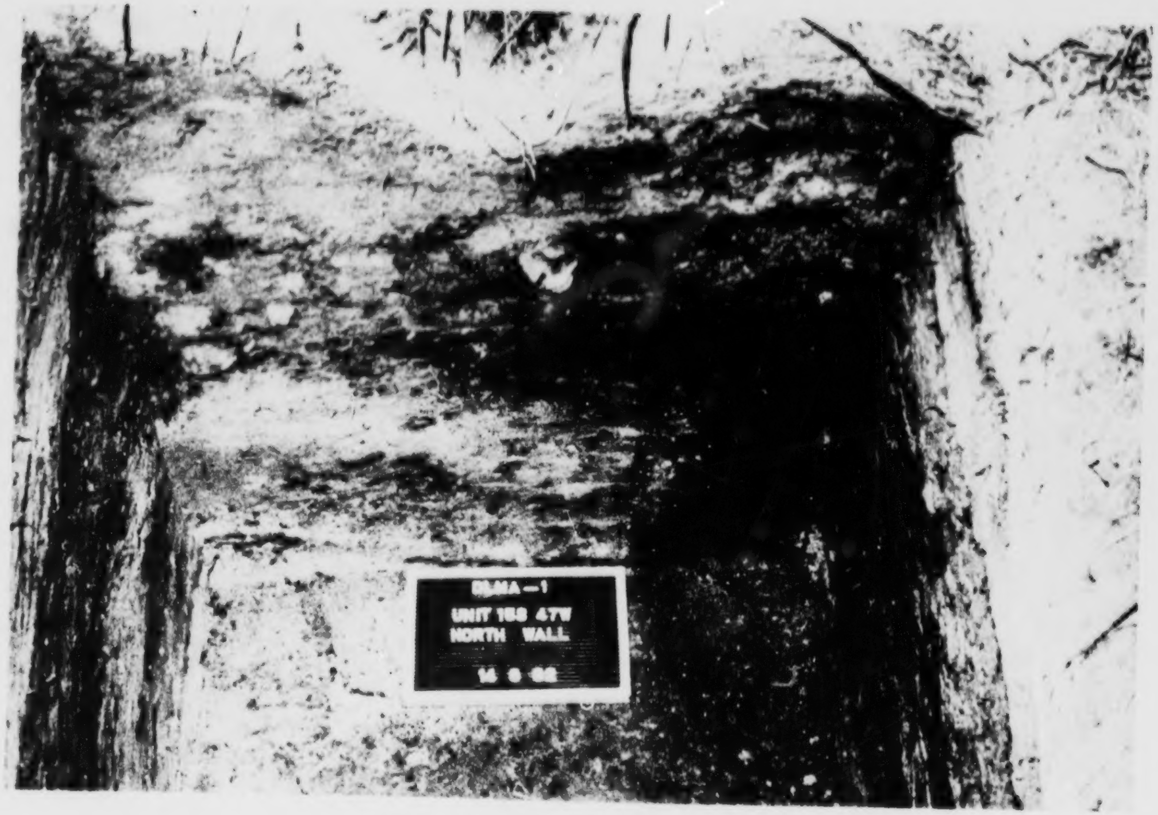


Figure 87. Evidence of vertical bone feature in Unit 177.

A search of the literature reveals a variety of archaeological sites throughout the Northern Plains and Parkland regions in which pits with vertical bone have been found. In Manitoba, the Avery site, DhLs-1, west of Pilot Mound on the shores of Rock Lake contained an undetermined number of individual bison bones oriented vertically in the ground.

> Other than the hearths reported by Vickers only one other type of feature was encountered. This was the right distal half of a bison radius standing in a vertical position in unit 48E12S and extending from a depth of 5 centimeters to 25 centimeters. It was not possible to determine whether the bone had been thrust into a hole, and was thus intrusive into the upper levels of the site, or whether the upper part of the bone was covered by natural soil deposition. Vickers (personal communication 1967) reported finding similar features at the site always consisting of a single vertical longbone and with no evidence of any meaningful arrangement (Joyes 1969:29-30).

On the basis of projectile point and ceramic typologies, as well as associated radiocarbon dates from other sites (1969:216-233), Joyes identified the following cultural sequence for the Avery Site (Table 55). Records are not extensive enough, however, to determine with which cultural grouping the vertical bone may have been associated: all groups represented relied primarily upon bison.

At the Brockinton Site, DhMg-7, located on the Souris River flood plain a few kilometres southwest of Melitia, Syms (1972) found 27 bone-filled pits running more or less parallel with the river. They occurred in the lowest of three occupations of a bison kill-butchering camp site and were associated with butchered bison and canid bones, as well as a variety of lithic materials. Unfortunately radiocarbon dates from the site are confusing. Two dates of A.D. 690 ± 130 (GAK 3805a) and A.D. 840 ± 80 (S-687) seem acceptable for Occupation III, but the stratigraphically higher

Occupation II dates to A.D. 595 ± 75 (S-688), which is not acceptable (Syms 1980:4).

TABLE 55

CULTURAL SEQUENCE AT THE AVERY SITE

CULTURAL GROUPING	DATE	ARTIFACT ASSOCIATION
McKean-Duncan-Hanna Phase	1000 - 1500 B.C.	8 projectile points
Pelican Lake Phase	500 B.C. - 1 A.D.	14 projectile points
Besant Phase	300 - 500 A.D.	28 projectile points; 31 rims Avery Corded Ware
Avonlea Phase	200 - 700 A.D.	39 projectile points; pottery association likely, but unclear
Manitoba Phase (Blackduck)	800 - 1400 A.D.	14 Blackduck rim sherds
Selkirk Phase	1300 - 1700 A.D.	60 Winnipeg Fabric Impressed Rim sherds

Syms concluded that the bone-filled pits at the Brockinton Site were likely post molds for a pound structure.

> Evidence of a structure is both remarkable and enigmatic. A lineal pattern of post molds became apparent during excavations....These post molds were 20-40 cm. deep and about 15-25 cm. in diameter. The holes containing burned post molds were sometimes artificially enlarged as a result of excavation.
>
> The structure that had been resting in these post molds had been taken down and the resultant holes had been packed with bones. In feature #18..., the hole had been packed with a complete radius and a complete sacrum in a vertical position and an acetabulum, all representing bison. Feature 27 had been packed with mandibles and scapulae blade fragments in a vertical position.
>
> The function of the structure is an enigma. Its lineal orientation along the base of the plains promontory

> suggests the possibility of a pound structure. If, however, this was a pound structure, the poles were not being driven deeply into the sand.
>
> There was no evidence to suggest that this was a former house structure. No hearths, semi-subterranean floors, or artifact concentrations that might be construed as a house remains were found (Syms 1972:19; 21).

A further, but certainly not exhaustive search of the literature revealed other instances of bone-filled pits in the Northern Plains of Canada and the United States. At the Mulbach Site (FbPf-100) in central Alberta,

> An interesting feature ... was the occurrence of a number of pits stuffed with bones of various kinds. In each case a number of large bones had been driven vertically together well into the yellow sand underlying the bone bed zone. ... The bones stuffed in these pits might include not only long limb bones, such as radii, tibiae, and femora, but also metapodials, mandibles, pelves, vertebrae, or small foot bones. The pits, which varied in diameter from about 20 cm to 40 cm, did not appear to protrude noticeably above the bone layer; they were uncovered and recognized only when the bones from this layer were being lifted.
>
> ... In the main area of excavation seven of the pits appeared to fall into two parallel lines about 2 metres apart, west and southwest of the zone of charred bone and trending northwest-southeast: the eighth bone-filled pit (in Square B10) in the main area was outside this pattern. The three other bone-filled pits, found in the east area of excavation, also appeared to be in a line, trending northeast-southwest (Gruhn 1971:139).

Gruhn did not find an acceptable explanation for the use of these pits, as there was no evidence of a pound structure revealed during excavations. Cultural materials recovered were wholly Besant, with 89% of the projectile points fashioned of Knife River Flint (Gruhn 1971:142). A radiocarbon date of A.D. 680 ± 150 (GSC-696) is not inconsistent with other Besant dates on the Plains.

In Montana, Kehoe (1967:33-34) reports bone-filled pits at the Boarding School and Rinehardt Bison Drive Sites and Neuman also mentions a similar site on the Milk River near Saco, Montana (1975:32). Only the Boarding School Site material has been published extensively and at this locale Kehoe uncovered two groupings of upright bones in a layer of brown sand beneath the earliest bone bed. It was impossible to determine with certainty, however, whether these pits were associated with the early (Prairie Side-Notched) or later (Plains Side-Notched) components at the site. Kehoe also mentions (1973:168) the Ruby Site, 48CA302, in northeastern Wyoming, excavated and analyzed by George Frison (1971). The site is single component and contains portions of a pound, drive line and ceremonial structure.

> ... Post holes show the pound enclosure and drive lane but none of the structure is preserved. The drive lane makes a sharp bend 40 feet from the enclosure obscuring the enclosure from the bison. The lines of post 2 to 4 feet apart, are expanded 8 feet wide at the bend and widen to a maximum of 11 1/2 feet and eventually formed diverging wings. Post remains were of juniper and these were tightened in the holes with bison long bones (Kehoe 1973:168).

Large corner-notched Besant-like points were associated with the remains and a radiocarbon date of A.D. 280 ± 135 (GX-1157) was obtained.

Wettlaufer (1955) was the first to publish data on bone-filled pits in Saskatchewan. From Occupation 4A at the Mortlach Site, he described a semi-circular series of "post-holes" which he considered to be the remnants of the supporting framework of a small house or structure of some sort.

> ... Unfortunately no centre pole structure or fire pit could be found since the area represented by the centre of the circle had previously been destroyed by amateurs. Several things are worthy of note: (1) There seemed to be a double line of holes. (2) The holes were quite shallow, only going down a few inches. ... They were much too shallow to support a heavy house type similar to the Mandan lodges of the south. (3) The holes were filled with bones and debris -- some of these bones were knuckle bones and seemed to have been deliberately pushed in alongside the poles to make them more secure. (4) No remnants of the

> poles remained in any of the holes. (5) Although shallow, the holes presented in cross-section a profile typical of post-hole structures. (6) There was no indication of a central structure for supporting the roof (Wettlaufer 1955:42-43).

Occupation 4A was one of four Besant occupations at the Mortlach Site; the adjacent 4B occupation, also Besant, dated A.D. 370 ± 325 (S-22). Another site in Saskatchewan with vertical bone is EcNb-8, the Walter Felt Site, only 15 km south of Mortlach on a terrace below the Missouri Coteau. "The buried bases of wooden corral poles and supporting bone uprights were discovered there" (Kehoe 1973:164). Radiocarbon dates range from A.D. 1550 to B.C. 480 with five components represented (Plains, Prairie, Samantha, Besant and Sandy Creek). Unfortunately Kehoe does not mention with which component the vertical bone is associated.

In South Dakota at the Stelzer Site, 39DW242, along the Missouri River in Dewey County, Neuman discovered some 88 "ubiquitous bone uprights" (1975:6) in the camping area adjacent to several associated burial mounds. The upright bones were scattered throughout the excavation areas with no apparent patterned distribution other than a general proximity to the camp middens.

> The uprights themselves are characteristically composed of large limb bones of bison. The shafts have been broken and their jagged end inserted into the ground, while the articular facet is upward only a few inches above the surface of the occupation level. In most instances the uprights consist of three or more bones packed tightly together, the articular heads of which would afford a useful platform to place a stone core for flaking or a large bone to be smashed for obtaining marrow (Neuman 1975:32).

Cultural materials included Besant-like projectile points, a preponderance of Knife River Flint and conoidal-shaped pottery vessels with plain or cord-marked surfaces. No radiocarbon dates were obtained from this site, but

Neuman considers it representative of the Sonota Complex on the Northern Plains dating between A.D. 1 - 600 on the basis of radiocarbon dates from comparable mounds and camp sites in the area.

Basically two explanations have been offered for the use of these bone-filled pits. At the Ruby and Walter Felt Sites, clearly they were part of the drive and pound structures used as bracing supports to hold wooden poles in place. Wettlaufer also interprets the Mortlach vertical bone in the same fashion, although none of the pits contained the remains of wooden poles (1955:43). Syms also considers the pits at the Brockinton Site to be post molds, with the vertical bones later additions. Based on ethnographic data gathered by Kehoe in 1971 (Personal Communication) that "the Blackfoot filled holes, such as rodent holes, around camp with bone so that people would not twist their ankles in these holes," Syms concludes that "While this interpretation is somewhat mundane, it may well be our best interpretation" (1972:22).

The second explanation for the utility of bone-filled pits involves their usage as anvils for stone working, bone smashing, etc. Both Kehoe and Neuman support this interpretation, primarily because similar European occurrences have been reported and interpreted as anvils by Semenov (1964). At Stelzer, Neuman found that many of the uprights were placed around a central stone that was even with the articulating surfaces of the bones, or that the bones surrounded an "empty pocket", which he considers to have once held stones. These stones would have been the anvils, then, supported by the surrounding upright bones (Neuman 1975:32). Neuman explains the absence of expected abrasion or impact scars on the uppermost surfaces of the bones, if they had been used as anvils, on the basis that they likely were covered with hides that would have made more even working surfaces and also protected the bones from damage (1975:32).

Neither of these two interpretations seem adequate to explain the vertical bone-filled pits at the Stott Site, however. None of the pits contained remnants of wooden poles, nor was there evidence of post molds *per se*. Conversely, none of the bone clusters surrounded a stone anvil, nor were there central gaps or "empty pockets" where stone anvils might have once been placed. If these bone uprights had been used as anvils for stone working, one would logically expect evidence to be present in the form of flakes, block shatter, etc. Yet in Units 102 - 104, cultural materials were practically nonexistent in comparison with recoveries from the "trench" or Unit 125. Roberts (Personal Communication) states that even with a covering of hide, the bone uprights would exhibit damage on their articulating surfaces if they had been used as anvils. Further, the upright bones discussed by Semenov (1964:171-173) all exhibited signs of abrasion, impact, et.

At this point it might be tempting to join with Joyes and Gruhn in saying, "I don't know what they are," in reference to the bone-filled pits. However, the location of the six pits at the same elevation in Area F hints at a pattern of distribution that is more than random. Using Wheat's typology (1978:84-89) for distinguishing types of sites containing bone beds, it was determined that Areas F and Upper B were likely camp sites rather than the locations where bison were killed and initially butchered. No doubt the kill site would be near by, but probably not on the valley wall. In his discussion of archaeological and historical evidence for bison drives on the Northern Plains, Kehoe (1973:158-189) illustrates the "typical" pound structure (Figure 88). If this diagram were applied to the Stott Site, one would expect evidence for the pound or corral to be found at the base of the valley wall on the flood plain of the Assiniboine River in what is now cultivated farm land.

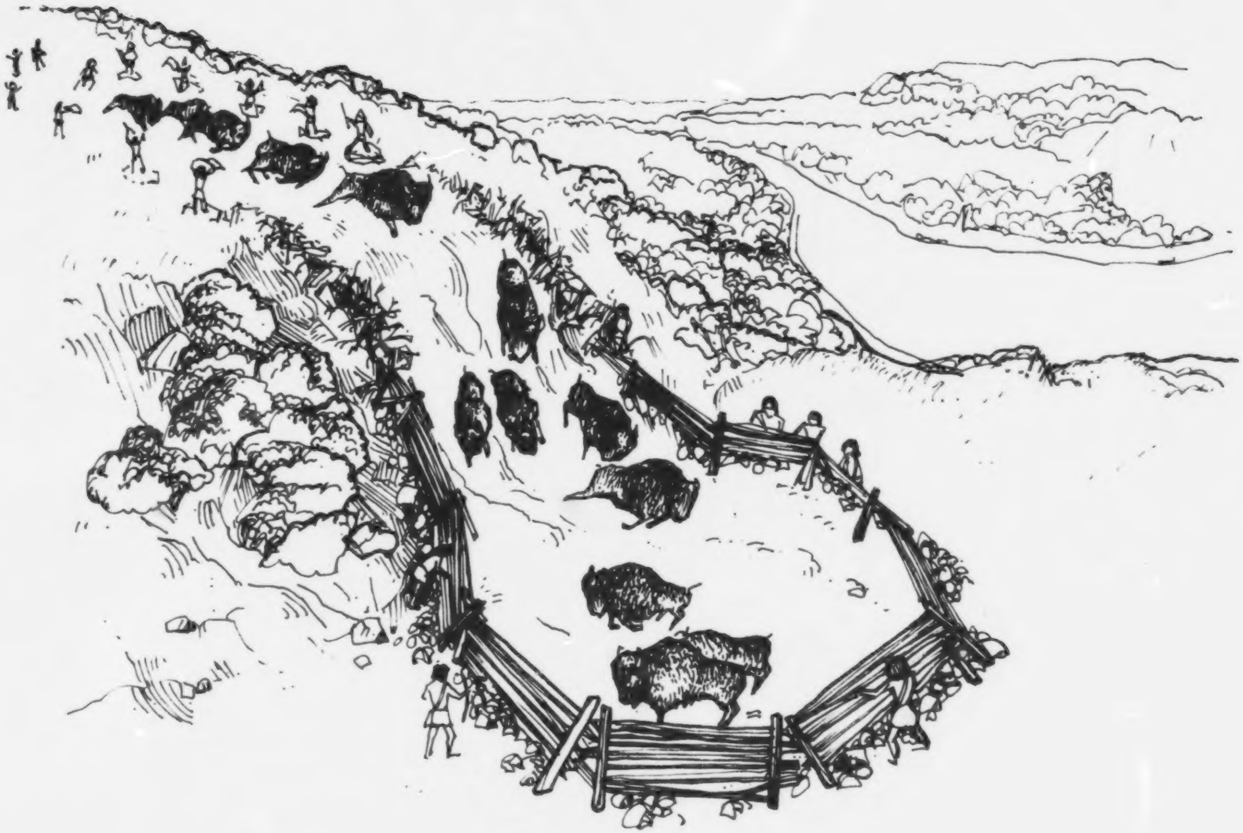


Figure 88. Running the chute.
(Adapted from Kehoe 1973: 184.)

Alternately in winter, bison could have been funneled to the river itself where they would have been dispatched easily in deep snow or on the ice.

If such a scenario is plausible, then the pits filled with vertical bone would be connected in some fashion with the drive lane or chute. Historical records show that these structures were marked in a variety of ways -- some with buffalo chips and brush in 1773,

> It is a circle fenced round with trees laid one upon another, at the foot of an Hill about 7 feet high & an hundred yards in Circumference: the entrance on the Hill-side where the Animal can easily go over; but when in, cannot return: From this entrance small sticks were laid on each side like a fence, in form of an angle extending from the pound; beyond these to about 1 1/2 mile distant. Buffalo dung, or old roots are laid in Heaps, in the same direction as the fence. These are to frighten the Beasts from deviating from either side (Cocking in Burpee 1908:109-110).

or others with poles in 1790:

> ... On that side at which the animals are intended to enter, a quantity of earth is laid, to the height of the construction, so as to form a hill of an easy ascent of about twenty feet. This done, a number of branches of trees are placed, from each side of the front, in a strait line from the raised hill, for about one hundred feet in length, continually increasing in width, so that though the inward ends of these lines of branches are no more than fifty feet asunder, the exterior end will exceed two hundred feet. After this, a number of poles, nearly fifteen feet long each, are placed at about twelve feet distance from each other, with a piece of Buffalo dung on the top, and in a strait line from the boughs above mentioned. At the foot of each pole a man lies concealed in a Buffalo skin, to keep the animals in a strait direction to the pound. These poles are placed alike on each side, always increasing in breadth from one side to the other.... (Umfreville 1954:160-162).

In many instances, then, the chute or drive line was not a solid wall, but rather a path way manned by people stationed at regular intervals, whose duty it was to keep the bison on their prescribed course to the pound. It seems possible that the six bone-filled pits in Area F and the one pit 24 m lower in

Area Upper B are remnants of just such a chute or drive line. If this were so, one would expect to find evidence of the kill site on the floodplain. In fact, during a visit to the Highways Department in Brandon during the 1982 field season, the senior author was told that if we thought we were seeing a lot of bison bone in the park and on the Stott farm, we should have been on the flood plain when the TransCanada Highway bridge was constructed over the Assiniboine River.

Research at the Manitoba Archives has revealed correspondence in 1954 between the Minister of Public Works, William Morton, and A.M. MacPherson, owner of the farm adjacent to Grand Valley Provincial Recreation Park on the east. Mr. MacPherson protested the original location of the TransCanada Highway through his property, not only because he would lose valuable farm land, but because this area flooded so frequently that the approach to the bridge would often be under water (letter from A.M. MacPherson to William Morton, May 9, 1954). From an engineering point of view, the main difficulty concerned getting the Highway down from the north valley wall to the designated river crossing at a grade that was not too steep.

> I am advised no detailed survey has been made on the location suggested by you but that several points on the Valley have been examined by our Engineers and they have agreed that the present river crossing location is about the best in the area, but just how to get down to this location from the north bank seems to be the problem (Letter from William Morton to A.M. MacPherson, November 9, 1954).

MacPherson had suggested previously that the road be moved west 1 - 1 1/2 miles for the easiest descent and the least disturbance to the farmers involved (Letter from A.M. MacPherson to William Morton, October 29, 1954). This is, of course, approximately the present location of the TransCanada Highway. The fact that the route proposed by Mr. MacPherson intersects the hypothesized parallel drive lines marked by bone-filled pits is probably not coincidental. Bison crossing the river from the prairie level would also seek the easiest way down the valley wall; prehistoric hunters would use this knowledge to their advantage in constructing a pound; eventually highway engineers would place their roadway in the same location.

Air photos of the floodplain (Figures 5 and 6) reveal many former channels of the Assiniboine River which, in the past, flowed much more closely to the northern valley wall than it does at present. No doubt the combination of floods and farming activities, as well as highway construction, have effectively eradicated any positive evidence of a pound *per se*. However, there is certainly abundant ethnographic evidence for procurement of bison in this part of the province in a variety of ways at all times of the year. Tanner describes a late winter hunt in 1795/96 which took place in this area.

> ... We continued here hunting beaver [near the NorthWest Company post on the Souris River], and killing great numbers until the ice became too thick: we then went to the prairies in pursuit of buffaloes. When the snow began to have a crust upon it, the men said they must leave me with the women, as they were about to go to Clear Water Lake [Riding Mountain] to make canoes, and to hunt beaver on their way down. But previous to their going, they said they would kill something for us to live on while they were gone. Waus-so, who was a great hunter, went out by himself, and killed one buffalo; but in the night the weather became very cold and stormy, and the buffalo came in to take shelter in the woods where we had our camp. Early in the morning, Net-no-kwa called us up, saying, there was a large herd close by the lodge. Pe-shau-ba and Waus-so, with Wa-me-gon-a-biew, Sa-ning-wub, and Sag-git-to crept out, and took stations so as nearly to surround the herd. Me they would not suffer to go out, and they laughed at me when they saw me putting my gun in readiness; but old Net-no-kwa, who was ever ready to befriend me, after they were gone, led me to stand not far from the lodge, near which, her sagacity taught her, the herd would probably run. The Indians fired, but all failed to kill; the herd came past my stand, and I had the good fortune to kill a large cow, which was my first, much to the satisfaction of

> my mother. Shortly afterwards, having killed a considerable number of buffaloes, the Indians left us; myself, the old woman, one of the young women, and three children, six in all, with no one to provide for them but myself, and I was then very young [15 years old]. We dried considerable of the meat the Indians had killed, and this lasted us for some time; but I soon found that I was able to kill buffaloes, and for a long time we had no want of food. In one instance, an old cow which I had wounded, though she had no calf, ran at me, and I was barely able to escape from her by climbing into a tree. She was enraged, not so much by the wound I had given her, as by the dogs; and it is, I believe, very rare that a cow runs at a man, unless she has been worried by dogs ... Buffaloes were so numerous about this place, that I often killed them with a bow and arrow, though I hunted them on foot, and with no other aid than that of dogs well trained and accustomed to hunt (Tanner in James 1956:43-44).

On the basis of the location of the vertical bone features, then, one can postulate a drive line angling down the valley wall from northwest to southeast, culminating in a pound structure on the flood plain in the general vicinity of Areas D and E located in Section 26, Township 10, Range 20 West on MacPherson farm land. This proposed location would also coincide with two former oxbow channels of the Assiniboine River (Figure 89). From the radiocarbon date on Feature 2 in Unit 102, A.D. 900 ± 95 (S-2319) and the date of A.D. 850 ± 150 (SFU-224) on bone above the vertical bone-filled pit in Unit 57, one can also argue that the drive line is at least an Early Blackduck manifestation at the site and not necessarily associated with any or all expressions of the bone bed revealed through the many discontinuous archaeological excavations.

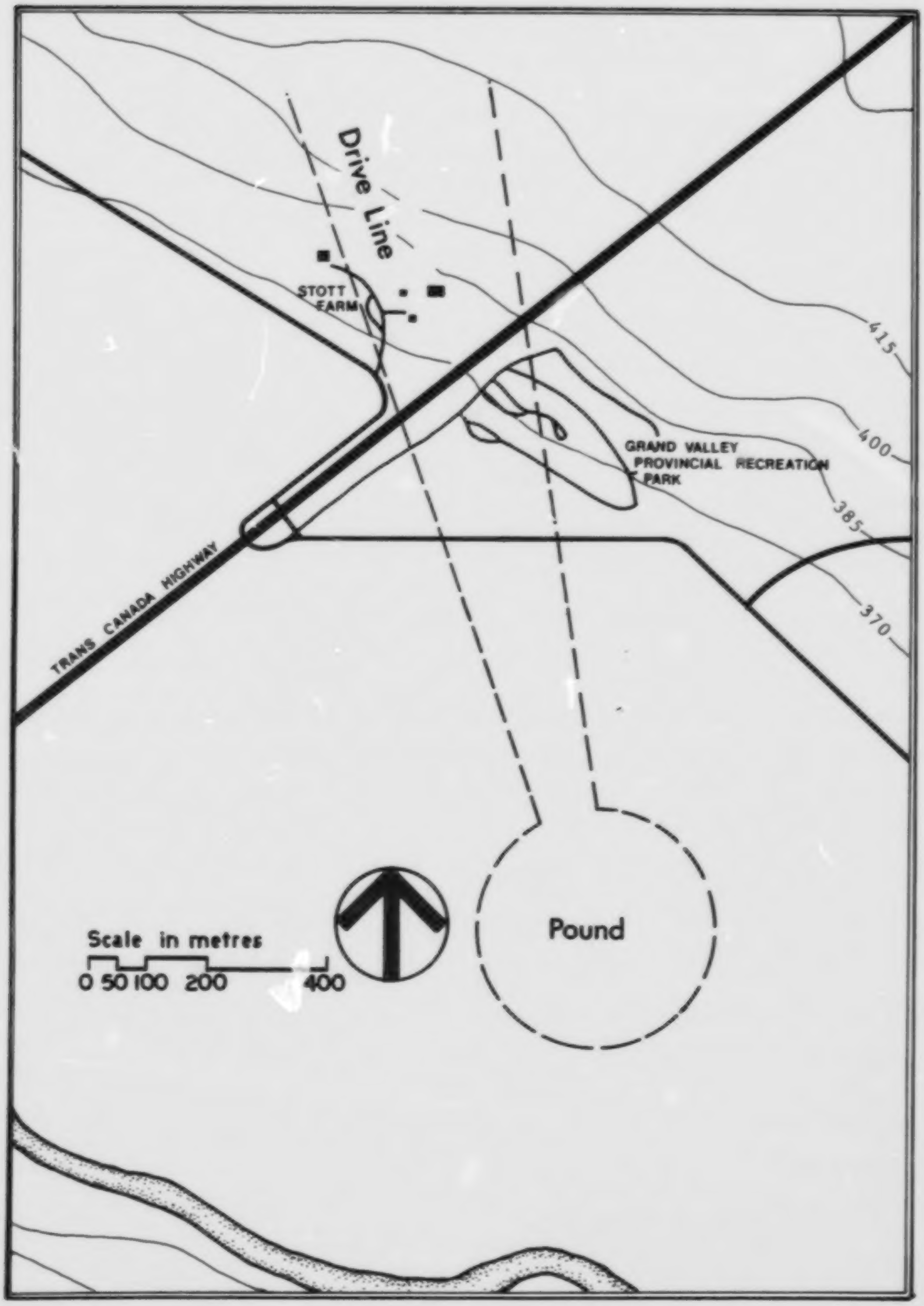

Drive Line
STOTT FARM
GRAND VALLEY PROVINCIAL RECREATION PARK
TRANS CANADA HIGHWAY
415
400
385
370
Pound
Scale in metres
0 50 100 200 400

Figure 89. Hypothesized location of bison drive line and pound.

CHAPTER V

INTERPRETATIONS AND CONCLUSIONS

Although the primary goal of the 1982 field season at the Stott Site was the salvage of archaeological remains jeopardized by expansion of the TransCanada Highway, and the main thrust of this report has been a description of the artifacts recovered from this salvage operation, there still remains the task of discussing those six problems which were raised in Chapter I:

1. a determination of the depositional and erosional history of soils at the site;
2. a determination of the activities that were carried out at the site;
3. a determination of the season(s) of the year in which these activities took place;
4. a determination of the relationship of the farm to the park portions of the site;
5. an investigation of the number of archaeological components at the site; and
6. an investigation of the relationship of these component(s) to the burial mound.

SOILS HISTORY

The emphasis placed upon soils analysis and a determination of the depositional and erosional processes occurring at DlMa-1 in the past has resulted in a fuller understanding not only of the processes themselves, but also of their effect upon the physical landscape and the cultural materials discarded on it.

-- Geomorphologically, the oldest recognizable portion of the landscape is the terrace comprising part of Area F on the farm side of the site. Excavation Units 99, 100, 101 and 125 were located on this terrace in 1982, as well as some of the 1979 field school units and test pits.

-- Sedimentologically, soil profiles from all units reveal deposits comprised of reworked lacustrine and/or till materials that have eroded downslope from higher elevations.

-- Pedogenetically, most classified soils are characterized as Regosols, that is, soils with weak horizon development resulting from factors such as youthfulness and/or instability of the component materials.

The implications of these findings for interpretation of archaeologically recovered materials are inescapable. The valley wall with its readily observed gullies, bowed trees, slumpage and mud slides is more stable now than at any time in its recent past. Its history has been one of erosional forces, primarily water-lubricated earth movements, reworking the landscape, interspersed with relatively brief periods of stability during which prehistoric hunters killed bison and processed meat in camps on the valley wall. Ironically, the only region excavated in 1982 where erosional forces might not have adversely affected the stratigraphic arrangement of artifacts and features, the block of Units 119-124 located in Area Upper B in the Park, contained little cultural material. Elsewhere on the site, all cultural remains were located in soils comprised of reworked material and, at this point, it is not possible to separate with certainty in situ cultural debris from that which has literally "slid in" from upslope positions. Consequently, until further studies clarify this situation, the stratigraphic positioning of cultural remains should not be utilized for interpretative purposes at DlMa-1.

ACTIVITIES

It appears as if the initial decision to broaden the scope of this report to include some data from previous years' excavations has not been unwise. Although the lack of time for full analyses proved constantly frustrating to all involved, data from prior excavations provided both information and ideas about who used the site, when, why, and for how long. No doubt the best example of how this approach has "paid off" is in recognition of a drive line extending down the valley wall onto the flood plain. Only by combining data from four individual projects was it possible to get some understanding of the meaning of the otherwise inexplicable V-shaped pits containing vertically placed bison bone.

Therefore, the central activity postulated to have taken place at the Stott Site is that of driving bison from the prairie level on the north and west, over the valley wall onto the Assiniboine River flats, where the animals were likely impounded in a constructed pound or natural trap formed by oxbows in the river (see Figures 5 and 6), or were mired in mud, snow or on the river ice, depending on the season of the year. Likely that portion of the drive line recognized in Areas F and Upper B relates to a previously defined Early Blackduck occupation. A radiocarbon assay of A.D. 900 ± 05 (S-2319) from Area F dates a portion of the drive line directly, while another of A.D. 850 ± 150 (SFU-229) lies immediately above a part of the drive line in Area Upper B. Considering the physical size of the Stott Site and the range of radiocarbon dates obtained, it is surely unlikely that this particular drive line was the only one ever constructed at the site. No doubt natural and human forces have combined to eradicate most other evidence.

It is presumed that the killing and initial butchering activities took place on the flood plain in Areas D and E, where no concentrated archaeological excavations have occurred. Following these activities, bison quarters and other selected parts of the animals were carried or dragged partially up the valley wall where camps were made and the meat and bones processed. Likely some of these camps lasted for quite a while. From the condition of the bone, it is obvious that much of it was boiled to make grease or bone "butter". The presence of unifacial scraping tools indicates hide working and other related domestic activities, the amount of lithic debris points both to the manufacture and refurbishing of stone tools. In addition to bison, bones of other species were present in the bone bed. As well, the interiors of many of the ceramic vessels were encrusted with cooking residue. All of these factors indicate that at least some of the camps were not brief stays. Tanner's biography (James 1956) details several occasions when the women and children of his party were left in a camp (generally in the Aspen Parkland) where food was thought to be easily obtained and plentiful, while the men went off to hunt, trap, make canoes, etc.

SEASONALITY

Several avenues of investigation can contribute information to the question of season(s) of occupation at the Stott Site. Contemporary studies of bison behaviour, as well as historical records, document the movement of bison from the Northern Plains to the Aspen Parkland in relatively regular seasonal rounds. Morgan's ecological study of bison behaviour as revealed at the Garrett Site in southcentral Saskatchewan (1978) demonstrates a predictability of bison movement based upon the seasonal availability of high protein grasses.

> Generally on a year-long basis, the availability of superior forage appears to be the major stimulus of pronounced bison movements. In spring, on the winter range, the emergence of new spring grass on the exposed grassland areas prompts major movements of herds out of sheltered areas. The emergence of new spring growth of Bouteloua gracilis stimulates major movements onto the summer range. In fall, movements into the winter range are initiated by the attraction of grasses that are still green and nutritious. A co-determinant of fall movement patterns is the availability of water. After winter snows, if weather conditions are favorable, significant herd movements onto the open grassland areas occur as water resources are no longer a restrictive factor. Major winter movements are prompted by the need for shelter, although the availability of grasses of high forage capacities in association with these areas is an essential requirement.
>
> In considering the overall dynamics of the annual cycle, emphasis must be placed on the two-field rotation system. Briefly, the shift of the bison populations to the summer range occurs at a time when the heavily utilized grasslands of the winter range can still undergo rejuvenation. The herds return when most of the normal growth and development of the grasses is completed, thus guaranteeing sufficient forage during the winter when mobility is restricted and adverse climatic conditions predominate. Therefore, herd movements within the framework of a two-field rotation system are highly significant in ensuring maximum survival of the bison populations (Morgan 1978:133-134).

The Garratt Site is located within the range of bison herds that moved primarily north and south, whereas in Manitoba, seasonal movement between ranges was more of an east-west nature.

> The bands belonging to the Red River Range winter on the Little Souris, and south-easterly towards and beyond Devil's Lake, and thence on the Red River and the Shayenne. Here, too, they are found in the spring. Their course then lies west towards the Grand Coteau de Missouri, until the month of June, when they turn north, and revisit the Little Souris from the west, winding round the west flank of Turtle Mountain to Devil's Lake, and by the main river (Red River) to the Shayenne again (Hind 1971:2:108).

Despite these directional differences, the more easterly bison herds in Manitoba also moved from the Aspen Parkland to the Northern Plains in a seasonal round that maximized the quantity and quality of foodstuffs available to them. Morgan also points out that favorable localized conditions could permit some herds to remain virtually year-round in one location.

> ... No doubt certain localities in the study area maintained resident herds on a year-long basis. The evidence suggests that the winter range is the most suitable ecologically, although sheltered areas do exist on the summer range that could support resident winter herds (Morgan 1978:133).

In general then, the Stott Site is ideally positioned for the regular procurement of bison during the fall, winter and spring seasons of the year as well as the occasional summer, depending, of course, upon the specific conditions of any year that might be considered.

The presence of a drive structure also contributes evidence for the time of occupation of the Stott Site. Using historic records from the period 1754-1880, George W. Arthur (1978) argues convincingly that the assumption among ethnohistorians and anthropologists that bison drives were utilized only in the fall is erroneous. Historic records from all parts of the Northern Plains for this time document Native utilization of drives throughout the winter as well as fall months. Tanner's narrative for the winter of 1795/96 in the Parkland, quoted in the preceding chapter, describes the procurement of bison by driving a herd, although it is unclear from his description whether an actual drive structure and pound were involved. General ecological and historical data indicate that the Stott Site could conceivably have been utilized on a yearly basis, at least during environmentally optimal years. However, the most likely time of occupation, in order of descending probability, was winter, fall, spring and summer.

Certainly one could hope that the bison bone itself would be able to provide some evidence for season of occupation. Unfortunately, for a variety of reasons, not much definite information can be obtained from this source. The major difficulty involves the inability, at least at this point in time, to assign any of the bone to any of the archaeological components thought to be present at the site. For example, on the basis of radiocarbon dates, it is known that at least two Blackduck occupations are present at the site. However, with the possible exception of the units from which these dates were obtained, one does not know where bone from other units should be assigned. This problem is compounded by the presence of non-Blackduck ceramics in significant numbers, as well as projectile points thought to be both chronologically older and younger than Blackduck associated lithics.

As a result of the inability to distinguish components, Roberts has had to identify and analyze the bone as if it were the residue of a single occupation. In Chapter III, on the basis of right proximal metatarsals and right distal humerii, respectively, she identifies ten bison in Area F and four in Area Upper B from the 1982 excavations alone. In order to age these animals, however, she was forced to rely upon mandibles, of which only 12 were recovered in 1982. These 12 ranged in age from a calf less than one year old to an individual between 12 and 15 years old (Table 6). The sexing of individuals involved yet another element -- the proximal front phalanx. When these specimens were removed from the 1975 and 1976 bone recovered in Area G, as well as the 1979 and 1982 materials from Area F, and the 1977/1981/1982 materials from the park, they totaled 43 female and 47 male phalanges. Based on a count of four proximal front phalanges per animal, a total of 11 female and 12 male bison was estimated for the entire site from all excavations since 1975. Because a "typical" fall/winter herd does not contain adult males, the figure of 11 females and 12 males for the site seems possibly significant. It would be most desirable to be able to determine the sex of the 12 bison from the 1982 excavations listed in Table 6, but unfortunately impossible to calculate. There is no way to determine the relationship of the male and female phalanges to the 12 bison, whose age was estimated from mandibles. Therefore, herd composition and, by association, season of the year remain unknowable from the faunal remains.

Other potential indicators of seasonality frequently mentioned are the presence of foetal bone, molluscs and fish. Foetal bison bone is extremely difficult to identify specifically. None was recovered in 1982 and only small amounts reported for 1976, 1979 and 1981. Depending on the maturity of the bone, it could indicate either winter or spring occupation. Although molluscs would be utilized as food primarily during the summer, if shells were being gathered for other domestic purposes, they would be most readily available in the fall when water levels in the river would be low. The presence of fish, also, seems to indicate a nonwinter occupation, but because scales are the major item recovered, it is impossible to get even an estimate of how many fish are present. Therefore, the previous seasonal estimates of winter, fall, spring and summer in descending order of probability will have to suffice until future analyses provide more conclusive evidence.

If excavations at DlMa-1 had been placed at pound or kill locations rather than in camp areas, it might have been possible to investigate population structure and seasonality with some confidence. At various catastrophic bison kill sites on the Plains, other researchers (Reher 1970, 1973, 1974: Frison 1978) have been able to accomplish relatively sophisticated analyses of both herd composition and season of occupation. Such analysis, however, requires a kill site with well defined stratigraphy; neither prerequisite has been met in Stott Site excavations to date.

ARCHAEOLOGICAL COMPONENTS

Another issue that has benefited from the pooling of data gathered during 40 years of investigation at the Stott Site has been that of the numbers and identities of archaeological components. Because the proportion of Blackduck vessels among the ceramic recoveries has always been so high for each excavation, it has been expedient to either ignore the vessels that don't fit within the Blackduck system or to force them into it. On this basis, then, DlMa-1 has been generally regarded as a Blackduck bison kill site with occupations centred around two time periods -- A.D. 800 and A.D. 1200 (Tisdale 1978:100). Closer scrutiny of some of the artifacts recovered in prior excavations indicates that the number of components at the site is probably greater than assumed.

Unfortunately delineation of components is hampered by the lack of reliability previously demonstrated to exist in the vertical relationships between artifacts. In addition to the natural erosional forces operative on the valley wall, one cannot discount the effect that traffic, both animal and human, must have had on the refuse discarded there. Not only is the drive line direct evidence of bison herds moving downslope through the encampment areas, there also would have been considerable pedestrian traffic on the slope as carcasses were hauled up the hillside to be processed. Such a scenario helps to explain the excessively fragmented and scattered remains of pottery vessels. Ordinarily one would expect that, in a camp setting, at least some vessels would be recovered in sufficient quantity for reconstruction. Yet at the Stott Site there are no extensive pottery reconstructions, because there are no undisturbed areas that have been excavated. Therefore, at this stage of nonsophistication in locational anayses, one is forced to rely primarily upon the presence of particular ceramic and projectile point styles at the site as indicators of the components present. Defining components in terms of vertical location is not possible at this time, although the horizontal positioning of diagnostic materials on the valley wall seems less affected by disturbance factors and therefore, more reliable.

Throughout the years of investigation at DlMa-1, a series of 17 radiocarbon dates has been obtained from the site (Table 56). Not all of these, of course, directly date cultural materials that are diagnostic of specific components. Furthermore, those that are associated with significant cultural remains do not necessarily agree with chronological assessments from elsewhere on the Northern Plains and its periphery. Table 57 lists the excavation units, the diagnostic materials associated with the radiocarbon dates and comments about the acceptability of these associations. Figure 90 displays the location of the proposed archaeological components within the various subareas of the site. Components associated with radiocarbon dates are indicated in upper case letters; those associated with artifacts only are indicated in lower case letters.

Archaic The late Archaic date on bison bone recovered in Area A (GX 5143) was unfortunately not associated with cultural materials that were obviously Archaic. However, Archaic style projectile points have been recovered in Area C on the flood plain and also in Area I, the cultivated fields on the prairie level north and west of Areas F and G near the mound. Additionally, one Pelican Lake point was recovered from Area G.

Initial Woodland This component is represented only by the four Avonlea projectile points recovered from Areas F and G.

TABLE 56
STOTT SITE RADIOCARBON DATES

Location	Material	Late Terminal Woodland	Middle Terminal Woodland	Early Terminal Woodland	Archaic	Reference
AREA A						
Unit 14	Composite Bone[1]			A.D. 730 ± 135		GX 5139 (G)[2]
Unit 15	Charcoal	A.D. 1595 ± 115				GX 5140
Unit 16	Composite Bone		A.D. 900 ± 145			GX 5141 (A)[3]
			A.D. 1235 ± 140			GX 5141 (G)
Unit 17	Composite Bone			A.D. 340 ± 160		GX 5142 (A)
				A.D. 750 ± 135		GX 5142 (G)
Unit 21	Composite Bone				B.C. 720 ± 155	GX 5143 (A)
					B.C. 1145 ± 160	GX 5143 (G)
UPPER B						
Unit 33	Composite Bone		A.D. 1170 ± 105			GX 5175 (G)
Unit 34	Composite Bone		A.D. 1210 ± 105			GX 5174 (G)
Unit 87	Bone[4]			A.D. 850 ± 150		SFU 229 (G)
LOWER B						
Unit 53	Charcoal			A.D. 630 ± 135		GX 5177
Unit 55	Composite Bone		A.D. 1130 ± 130			GX 5176 (G)
Unit 98	Composite Bone			A.D. 810 ± 240		SFU 224 (G)
AREA F						
Unit 99	Humic Acid				B.C. 2250 ± 115	S 2320
Unit 102	Bone			A.D. 900 ± 95		S 2319 (G)
Unit 125	Bone			A.D. 910 ± 90		S 2318 (G)
AREA G						
Unit 5	Composite Bone			A.D. 840 ± 60		S 1272 (G)
Unit 5	Composite Bone			A.D. 910 ± 45		S 1273 (G)
Mound	Bone (Composite?)			A.D. 595 ± 60		S 1303 (G)

[1] Several elements or fragments of elements
[2] Date based on gelatin
[3] Date based on apatite
[4] One element

Table 57
ARCHAEOLOGICAL COMPONENTS AT THE STOTT SITE IN DATED CONTEXTS

Location	Late Terminal Woodland	Middle Terminal Woodland	Early Terminal Woodland	Archaic	Cultural Materials	Comments
AREA A						
Unit 15	A.D. 1595 ± 115				Irvine Narrow Square-Base projectile point 15-6-5	A.D. 6-1200; post A.D. 750; see Table 45
Unit 17			A.D. 340 ± 160 A.D. 750 ± 135		Vessel 1 (cord-wrapped object impressed & bossed) Mode II; Vessel 4 (incised lines) Mode I	Early Blackduck; A.D. 960 see Table 18
AREA UPPER B						
Unit 33		A.D. 1170 ± 105			Unclassified projectile point 33-6-5; Nanton Wide Rounded-Base projectile point 33-11-1	AD 6-1700; see Table 45
Unit 34		A.D. 1210 ± 105			Vessel 17 (plain with single row punctates) Mode X; Shaunavon Truncated Base projectile point 34-7-2	Mode X of dubious Blackduck affiliation

Location	Late Terminal Woodland	Middle Terminal Woodland	Early Terminal Woodland	Archaic	Cultural Materials	Comments
Unit 87			A.D. 850 ± 150		Vessel 3 (cord-wrapped object impressions) Mode VI; Irvine Narrow Square-Base projectile points 87-C3-129 and 87-D6-640; Lewis Narrow Rounded-Base projectile point 87-D5-516	Late Blackduck A.D. 1165; see Table 18; A.D. 6-1200; post A.D. 750 (Irvine); A.D. 6-1600 (Lewis); see Table 45
AREA LOWER B						
Unit 53			A.D. 630 ± 135		Vessel 6 (dentate stamped & bossed) Mode II	Mode II of debatable Blackduck affiliation
Unit 55		A.D. 1130 ± 130			Vessel 2 (dentate stamped & bossed) Mode undetermined	
Unit 98			A.D. 810 ± 240		Vessel 5 (dentate stamped) Mode I; Vessel 14 (cord-wrapped object impressed & bossed) Mode II: Tompkins Side-Corner-Notched projectile point 98-B5-260; Plains Triangular projectile Point 98-B5-273	Early Blackduck; A.D. 960; see Table 18; A.D. 800; (Tompkins); Late Prehistoric (Plains Triangular); see Table 45

Location	Late Terminal Woodland	Middle Terminal Woodland	Early Terminal Woodland	Archaic	Cultural Materials	Comments
AREA F						
Unit 99				B.C. 2250 ± 115	Vessel 30/Mode VI	Cultural material not consistent with date of soil horizon; carbonate contamination?
Unit 102			A.D. 900 ± 95		V-shaped pit with vertical bison bone; Vessels 46 (Unclassified) and 47 (Mode I) also present, but not directly associated	C-14 date pertains to the vertical bone; Vessel 47 would be Early Blackduck; A.D. 960; see Table 18

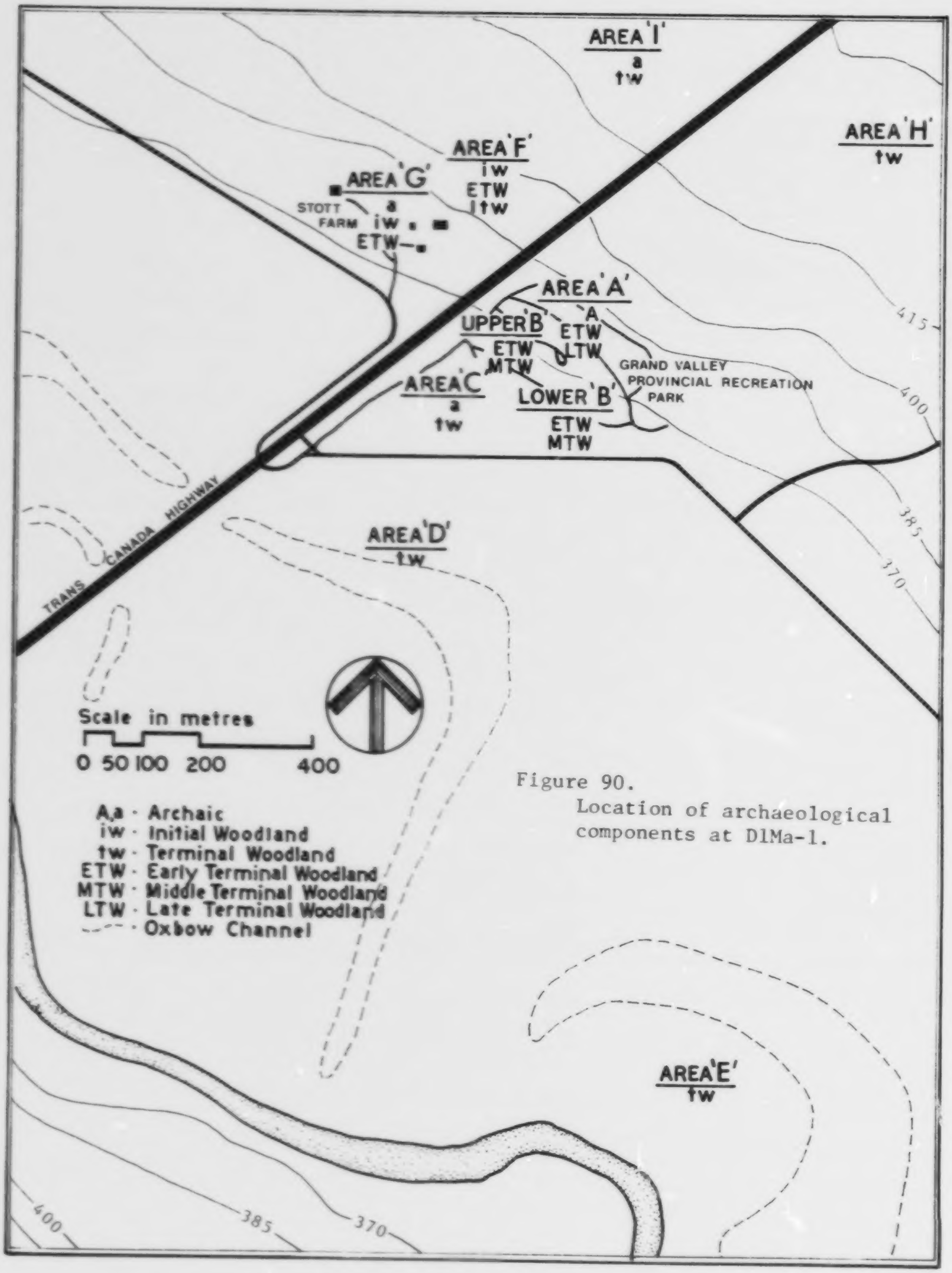

AREA 'I'
a
tw
AREA 'H'
tw
AREA 'F'
iw
ETW
ltw
AREA 'G'
a
iw
ETW
STOTT FARM
AREA 'A'
A
ETW
LTW
UPPER 'B'
ETW
MTW
AREA 'C'
a
tw
LOWER 'B'
ETW
MTW
GRAND VALLEY PROVINCIAL RECREATION PARK
TRANS CANADA HIGHWAY
AREA 'D'
tw
AREA 'E'
tw
415
400
385
370
400
385
370
Scale in metres
0 50 100 200 400
A,a - Archaic
iw - Initial Woodland
tw - Terminal Woodland
ETW - Early Terminal Woodland
MTW - Middle Terminal Woodland
LTW - Late Terminal Woodland
Oxbow Channel

Figure 90.
Location of archaeological components at DlMa-1.

Early Terminal Woodland/Early Blackduck In Area A, Unit 17 contained a cordwrapped object impressed and bossed pot (Vessel 1) indicative of the "early" period of Blackduck as defined by Lugenbeal. The combination of date and pottery style seems consistent in this location, although the date is much older than that obtained by Lugenbeal for his Early Blackduck. In Area Upper B, a date of A.D. 850 ± 150 (SFU 229) was associated in Unit 87 with a Mode VI pot (Vessel 3) and three projectile points. Again, the date received is too old for the type of pottery present (if Lugenbeal's findings are directly transferable to DlMa-1), but the three projectile points are consistent. In Area Lower B, two radiocarbon dates were recovered, A.D. 630 ± 135 (GX 5177) from Unit 53 and A.D. 810 ± 240 (SFU 224) from Unit 98. A cordwrapped object impressed and bossed pot (Vessel 14) was present in the latter unit, but the rest of the pottery present in these units consisted of non-Blackduck dentate stamped, or dentate stamped and bossed vessels. In Area F, the date on the vertical bison bone also fell within this time period (A.D. 900 ± 95 (S-2319), as did the two dates from Unit 5 in Area G.

Middle Terminal Woodland/Late Blackduck Two areas within Grand Valley Park, Upper B and Lower B, contained Late Blackduck radiocarbon dates. In Upper B dates of A.D. 1170 ± 105 (GX 5175) and A.D. 1210 ± 105 (GX 5174) were received, the former associated with projectile points in Unit 33 and the latter with a Mode X pot (Vessel 17) in Unit 34. Although these dates are consistent with Lugenbeal's definition of Late Blackduck, the inclusion of Mode X vessels within the Blackduck typology is debatable.

Late Terminal Woodland The only portion of the site with a Late Terminal Woodland date is Area A. Associated with this date is an Irvine Narrow Square-Base projectile point, which is not unacceptable. Most certainly there is a more extensive locus of Late Terminal Woodland materials in Area F, however. All but one of the Plains type of side-notched projectile points, which are chronologically the latest of this style, were recovered from Area F, along with most of the Mode X vessels. It would appear not unreasonable to postulate that they represent a Late Terminal Woodland/post Blackduck component of the site centred (for the time being at least) in Area F.

Left unexplained in this assignment of artifacts to components are three groups of ceramic vessels -- dentate stamped; dentate stamped or cordwrapped object impressed and bossed; and incised (Figures 54-58). The five vessels which are cordwrapped object impressed and bossed (68-8-133; 17-5-5; 96-B8-568; 94-B3-83; and 98-B8-474; Plates 55b; 57c; 58e, f, g) are disposed of most easily by placing them in the Blackduck Mode II category, despite the fact that not all vessel forms, rim profiles, surface treatments, etc. are typically Blackduck. Nevertheless, Lugenbeal's Cluster II within his Early Blackduck group seems broad enough to encompass these five vessels. The one vessel from Area F, 68-8-133, is not in a dated context, but the remaining four from Areas A and Lower B are associated with radiocarbon dates that are acceptable as Early Blackduck (Tables 56 and 57).

Eight vessels have been identified at the site which are decorated with dentate stamps or dentate stamps and bosses. Area F contains only the dentate stamp and bossed variety with vessels 99-84, 101-12, 101-212 and 69-3-43 (Figures 54a, b, c and 55a) comprising the four pots. No radiocarbon dates are associated with these vessels. In Area Lower B, vessels 55-7-2 and

53-4-8 (Figures 58a, b) are also dentate stamped and bossed, while two others (95-B5-219 and 98-B4-189; Figure 58c, d) are only dentate stamped. Tisdale (Pokotylo and Tisdale 1982) identifies two other vessels in Lower B as dentate stamped, but this author considers them too fragmentary for inclusion.

Radiocarbon dates associated with these materials (Tables 56 and 57) are inconclusive. The date in Unit 53 (Vessel 6; 53-4-8) is A.D. 630 ± 135, but A.D. 1130 ± 130 in Unit 55 (Vessel 2; 55-7-2). Both vessels are dentate stamped and bossed. Dentate stamped Vessel 5 (98-B4-89) in Unit 98 is associated with a date of A.D. 810 ± 240. Tisdale (Pokotylo and Tisdale 1982) does not consider these vessels to be Laurel, the most obvious candidate for affiliation, although some analysts see Blackduck ceramics evolving from Laurel. She suggests (Pokotylo and Tisdale 1982):

> ... the best available candidate for comparison seems to be the St. Croix Stamped Series.... This is a late Middle Woodland to early Late Woodland series (circa AD 500 to 800) associated with the Arvilla burial complex and distributed very clearly, and almost exclusively, along the Prairie-Forest interface of Minnesota. The Stott Site, though farther north, is situated in the same ecological setting.

The St. Croix Stamped Series, as described by George (1979:169-174), does seem a possible option for the origin of the dentate stamped vessels, although none of the St. Croix vessels described are bossed. The chronological range is certainly acceptable and early enough to fit with either the end of the Initial Woodland or the beginning of the Terminal Woodland. Area F contains material associated with both components and Area Lower B with the Terminal Woodland.

Vessels decorated with incised lines seem to be concentrated within Area F on the Stott farm. One such pot (Figure 54d), Vessel 46 (102-19), was recovered in 1982 from Unit 102, which also contained the two vertical bone features. In 1979, 11 incised vessels were reported. The five excavated during the Field School are discussed in Syms et al. (1979). Of the six reported by Hamilton, only two (Figure 55c, d) could be located. A date of A.D. 900 ± 95 (Table 57) has been recovered from Unit 102, but no direct association of Vessel 46 with the vertical bone feature that was dated can be demonstrated.

To the east of the highway, one incised vessel has been recovered within each of the excavation areas. Vessel 4 (17-2-15) in Area A has been categorized as Mode I Blackduck, although incisions are not a typical Blackduck decorative trait (Figure 58c). In Area Upper B, Vessel 2 (86-D1-326) is a miniature incised vessel (Figure 58a), which definitely does not fit within the Blackduck modal system. In Area Lower B, Vessel 7 (94-B4-201) has an oblique/horizontal rim motif executed with incised lines, as well as oblique incisions on the lip. The rim interior is decorated with either a vertical dentate stamp or fine cord impressions. Only Vessel 4 from Area A was retrieved from a unit that was radiocarbon dated. Unit 17 produced two dates obtained by different processes on the same bone sample, A.D. 340 ± 160 and A.D. 750 ± 135 (Tables 56 and 57), and also contained Vessel 1, which was cordwrapped object impressed and bossed.

Because the sample size is so small and the area covered so large within the park, there is no point in attempting to say anything about the three incised vessels found there. Area F, however, does seem to contain a concentration of incised vessels. Syms (Syms et al 1979:132-133) considers incising a "Plains" trait not normally associated with Blackduck pottery or the Stott Site. He hypothesizes that "Zone F may be a localized social group, such as extended family, with a relatively high percentage of one Plains trait in the ceramics" (Syms _et al_ 1979:132). Placing these vessels, especially the 1979 recoveries, in a chronological framework is not possible at this time, although the exclusive presence of Late Terminal Woodland Plains Side-Notched projectile points within Area F makes it tempting to postulate their association.

RELATIONSHIP OF PARK AND FARM PORTIONS OF THE SITE

Another question under consideration has been that of the relationship of the farm and park portions of the site to one another. Because the site is so large, it has been both convenient and necessary to subdivide it into individual excavation areas. As a result, the individual areas have been analyzed separately, with few attempts made to interpret the site as a whole. The division of the site by the TransCanada Highway has contributed to this situation also. The 1982 crew at DlMa-1 was fortunate in that it was the first to excavate on both sides of the highway. Comparisons between the park and farm sides were made constantly as efforts moved from one region to the other. Real differences do seem to exist between the two parts of the site, but they may not be readily apparent at first glance.

The most obvious difference observed between Areas F and Upper B in 1982 concerned the amount of material recovered. Although nearly three times as many units were excavated in Upper B (20) as in F (7), by far most of the recoveries originated in Area F, as shown below in Table 58.

TABLE 58

COMPARISON OF RECOVERIES IN AREAS F AND UPPER B

	AREA F		UPPER B	
Material	Number	Per Cent	Number	Per Cent
Bone	53,982	81	12,661	19
Ceramic	606	74	208	26
Lithic	2,059	88	276	12

One interpretation of these figures would propose larger or longer occupations in Area F. Yet these two parts of the site are not unrelated, as demonstrated by the location of the drive line (Figure 89). Two alternative explanations suggest themselves:

1) Construction and landscaping activities within the park have affected the placement of cultural materials; or

2) For some as yet unspecified reason, the Native peoples exploiting bison at DlMa-1 preferred to carry out their camping and bison processing activities toward the western end of the site.

The latter explanation seems the more likely of the two. Obviously both natural and human forces have rearranged cultural materials in the park, but there is no evidence to indicate artifacts were removed from the park, that is, the disparity between the two areas is real. However, there may be a logical explanation for the apparent preference for the western portion of the site as a campground. That explanation concerns wind direction. Table 59 lists the average wind direction in the Brandon area for each month over a period of 30 years from 1950 - 1980. Sixteen wind directions are possible, eg. N, NNW, NW, WNW, W, etc., with the percentage figures below indicating how much of the time during that month the wind blew from the accompanying direction. The columns headed "1st", "2nd", and "3rd" contain the percentage and wind direction that was highest (1st), next highest (2nd), etc. for each month of the year.

TABLE 59

PREVAILING WIND DIRECTION IN THE BRANDON AREA[a]

	1ST		2ND		3RD	
Month	Per Cent	Direction	Per Cent	Direction	Per Cent	Direction
January	22	W	18	WNW		
February	17	W	13	WNW		
March	13	W	12	WNW		
April	11	ENE	10	E	10	NE
May	11	NE	10	ENE	8	NE
June	10	W	9	ENE	8	E
July	12	W	11	WNW		
August	10	E	10	W	9	ENE
September	13	W	11	WNW	9	E
October	13	W	12	WNW	9	NW
November	16	W	13	WNW	9	NW
December	20	W	15	WNW		

[a] Data supplied by the Climatology Department, Atmospheric Environment Service, Environment Canada, Winnipeg.

Assuming that this contemporary data is valid for the Brandon area a thousand years ago (not an unwarranted assumption), one notes that in general during the seven month period from September through March, prevailing wind direction at the site is from the west or northwest. If the drive and pound were utilized primarily in the fall and winter, and consequently, large numbers of animals were killed and butchered, likely one would not want to be camped down wind (east of the drive line inside the park boundaries) from the rotting carcasses.

This explanation could possibly account for the differential distribution of cultural materials between the farm and park portions of the site. As well, it may have other seasonal implications. If one expects fall and winter occupations to be located west of the drive line, then occupations east of the drive line would more likely occur in the spring and summer. In Table 58, 81% of the bone and 88% of the lithic recoveries are seen to have originated in Area F. However, only 74% of the ceramics recovered were found in Area F, which may have a seasonal explanation. In the spring and summer, bison would probably not be available in large numbers. Kills would more likely be of individual animals, drive lines and pounds would not be utilized, the amount of debris left would indicate camping and butchering activities, but not on a large scale. Pottery, however, would be more prevalent, because both its manufacture and maintenance are easier during the spring and summer months. In Area F, the amount of debris indicates more intense utilization of the site -- more people and more animals -- a scenario appropriate to the fall and winter seasons. In Area Upper B, the same sorts of activities were carried on, but on a much smaller scale and likely at a different time of the year.

Another difference that may exist between the farm and park portions of the site concerns the locations of some of the archaeological components identified at DlMa-1. Manifestations of an Early Terminal Woodland component represented by Blackduck pottery and associated dates in the A.D. 800 - 900 range exist throughout the site (Figure 90), but other components are more localized. Middle Terminal Woodland dates around A.D. 1200 are clustered in Areas Upper B and Lower B of the park, although an attempt to differentiate Early from Middle in terms of Blackduck pottery modes was not successful. Area Lower B also contained a concentration of dentate stamped and dentate stamped and bossed vessels, which may be affiliated with a Minnesota ceramic series, St. Croix Stamped, falling within the A.D. 300-800 range and probably predating the earlier Blackduck occupation of the site. Area A within the park produced Archaic and Late Terminal Woodland dates, but the materials associated with them are neither abundant nor diagnostic of these components. On the farm portion of the site, Areas F and G contained a few projectile points considered to be characteristic of Archaic and Initial Woodland components. None were found in datable contexts, however. Area F also contained abundant evidence for a Late Terminal Woodland component -- Plains Side-notched projectile points, incised vessels and fabric impressed, bossed or punctated, notched lip vessels -- although, again, no radiocarbon dates confirmed this interpretation.

CULTURAL AFFILIATION OF THE STOTT MOUND

Once the likelihood of the Stott Site being more than an Early and Middle Terminal Woodland, single component Blackduck site is established, then the question of the propriety of assigning the Stott Mound to the Blackduck component is no longer a rhetorical one. An affiliation between the mound and the campsites has been assumed ever since the first controlled excavation took place.

> ... It was felt that the materials from the village, plus those from the mound, would give a fairly complete picture of the material culture of the "mound builders" and yield information that would facilitate the tribal identification and cultural relationships of the people who had built the mound (MacNeish 1954:31).

However, several problems preclude an easy association of mound and campsites.

1) A radiocarbon date of A.D. 595 ± 60 (S-1303) on skeletal material from the mound places it earlier in time than the accepted initiation date for Blackduck (A.D. 800) to the east of Manitoba in the Upper Great Lakes region. This date is also earlier than any recovered at the site, excepting the Archaic date in Area A and the anomalous date from the buried soil horizon in Unit 99 of Area F (Table 56). The only date associated with cultural materials that overlaps the mound date is that of A.D. 630 ± 135 on charcoal from Unit 53 in area Lower B, which contained a dentate stamped and bossed vessel.

2) No artifacts were recovered from the mound that can be identified unequivocally as Blackduck. The presence of fabric impressed bodysherds in the mound fill was the evidence used to argue for the mound's identity as Blackduck. Yet this argument is not necessarily valid:

> ... The presence of Blackduck sherds in the mound fill can also be accounted for by the mounds being built in an area where a previous Manitoba Focus village had been and the debris subsequently being gathered up in the earth during the mound construction, or it can represent debris or offerings left by later occupants of the site. Vickers had

> the problem of not knowing how many ceramic complexes existed, how many occupations were represented in the surface collections, or the relative temporal framework of the various pottery types. To date, the Stott Mound ... is still the only mound which has been excavated with accompanying excavations of a nearby encampment: even the Stott Mound lacks diagnostic artifacts in association with the burials and can only be assigned to the village because intensive surface collections and recent excavations have failed to produce any ceramics other than Blackduck pottery (Syms 1978:63).

When Syms wrote the above comments in 1978, literally none of the dentate stamped, dentate stamped and bossed, or incised pottery vessels had been excavated. In 1983, it is no longer possible to claim exclusivity for Blackduck pottery at DlMa-1.

Obviously any thorough attempt to investigate alternate possibilities for cultural affiliation of the Stott Mound is far beyond the scope of this report. However, the general direction that such research might take can be suggested. Table 60 below gives details of the nine burials found within the Stott Mound (MacNeish 1954:21-30). Five pits (I-V) had been dug beneath the former ground surface. Two of these were fire pits containing no human remains. Pit III held an articulated canid skeleton, while Pits IV and V contained two and five burials respectively. The ninth burial was intrusive and found in Pit VI, which had been dug into the mound fill.

The Osfusen Mound in Minnesota, excavated by Wilford in 1938,

> ... is the type site for Blackduck burial practices. A total of 45 burials was discovered -- in pits below the mound floor, on the mound floor, and in the mound fill. The characteristic burial type in the mound was primary flexed burial, often in a sitting, or semi-seated position. Small mortuary vessels, somewhat different in shape and decoration from the average utilitarial vessel, were placed with a few (seven) of the burials (Lugenbeal 1976:72).

In addition to these small mortuary vessels, other grave goods were a flint knife, two bone harpoons and an unidentified bone tool, four tubular copper

TABLE 60

STOTT MOUND BURIALS[a]

				PITS		
	I	II	III	IV	V	VI
General Description	Fire Pit	Fire Pit	1-Canid	2-Adoles M 3-Adoles	4-Infant 5-Adoles 5-Adult M 7-Old F 8-2 Arms	9-Adoles
Type Burial	N/A	N/A	1-Artic	2-Flexed 3-Bundle	4-Bundle 5-Flexed* 6-Flexed* 7-Flexed# 8-N/A	9 Flexed
Associated Goods						
Oak Log	N/A	N/A	P	A	A	A
Ochre	N/A	N/A	A	P-2	P-4/8	A
Clam Shell	N/A	N/A	A	P-2	A	A
Columella Bead	N/A	N/A	A	P-2	A	P
Bird Bone Whistle	N/A	N/A	A	P-2	A	A
Elm Bark	N/A	N/A	A	P-2,3	A	A
Bison Skulls	N/A	N/A	A	P-2,3	A	A
Oak or Oak and Cedar Poles	N/A	N/A	A	P-2,3	P-4/8	A
Copper Stain	N/A	N/A	A	A	P-6	A
Oliva Beads	N/A	N/A	A	A	A	P

Adoles = adolescent; M = male; F = female; Artic - articulated; * = possibly seated originally; # = probably disarticulated before burial; N/A = non-applicable; P = present; A = absent.

[a] Data from MacNeish 1954

beads and two ulnae awls. Red ochre was sprinkled on many of the burials and some had been placed on sheets of birch bark (Evans 1961:107-112).

McKinstry Mound 2, also excavated by Wilford, is important "because it is the only Minnesota site other than Osfusen containing abundant evidence for Blackduck burial practices" (Lugenbeal 1976:73). Although there were some intrusive burials in the mound, 96 skeletons in six burial clusters were considered to be Blackduck, with two dates of A.D. 1190 ± 90 (I-796) and A.D. 1475 ± 110 (I-789) recovered (Stoltman 1973:26). The most characteristic burial items were small mortuary jars, 33 of which were recovered with the various skeletal clusters. Other associated goods included:

> ... 10 rolled, tubular beads, 11 coiled beads, and 1 fragment of sheet copper considered to have been a knife. Only 4 stone artifacts were definitely associated with a burial group. These include a small, triangular projectile point, a large ... stemmed spear point of Knife River chalcedony, and 2 polished tubular pipes, all found with Group VI. A small stemmed projectile point was reported in doubtful association with Group I. Bone-antler artifacts included with these burials were a bird-bone awl and a bird-bone tube (whistle?), an incised bone "dagger", and a unilaterally barbed elk antler harpoon.... Of shell were 5 snail-shell beads..., 2 grooved conch columellas ... and 2 disc-shaped beads cut from mussel shell ... Finally, 2 charred birch-bark containers were found..., one of which produced the radiocarbon sample I-789 (1475 ± 110 A.D.) Stoltman 1973:28.

Comparison of the Stott Mound with the two quintessential Blackduck mounds in Minnesota does not reveal much similarity. Presence of a bird bone tube or whistle, columella shell, and the use of red ochre and tree bark appear to be the only overlap of traits. Especially significant is the absence of any small mortuary vessels in the Stott Mound. In addition, the radiocarbon dates are not compatible with one another.

If, indeed, the Stott Mound is not affiliated with Blackduck, then what likely alternatives are there? Syms (1979) describes the Devils

Lake-Sourisford Burial Complex, which certainly encompasses the Stott Mound geographically. However, neither the diagnostic artifacts,

> ... smooth-surfaced mortuary vessels with incised designs and distinctive lip decorations, incised and plain gorgets made from marine whelk shell, pendants and beads made from the columella or spiral axis of the marine whelk shell, tubular pipes, and incised stone tablets (Syms 1979:284),

nor the range of dates, A.D. 1200 - 1400, are compatible with data from the Stott Mound.

If the Stott Mound does not resemble burial complexes that are of a Middle or Late Terminal Woodland age, then the obvious direction in which to look for comparable materials is toward earlier complexes. Syms (1977:87-91) contends that during the Initial Woodland period, southwestern Manitoba was occupied, at least seasonally, by two different Plains groups identified by their remains as the Valley and the Sonota Complexes. Although the Valley Complex is thought to have spanned the time period from A.D. 1 - 700, not inappropriate for the Stott Mound, its subsistence was highly dependent upon riverine based animals, not bison. Valley Complex pottery has been found in southern Manitoba, but not at the Stott Site. Syms considers Valley Complex materials as

> ... the remains of a group whose core area was the Central Plains and South Dakota, with a probable secondary extension up the Missouri River and into the Souris River basin. Southwestern Manitoba was peripheral to more southerly haunts (Syms 1977:88).

The Sonota Complex, as defined by Neuman (1975) from 10 archaeological sites located along terraces of the Missouri River and its tributaries, occupies the same time span as the previously discussed Valley Complex. At first look it seems an ideal candidate with which the Stott Site might be affiliated. Sonota mounds and associated campsite debris bear a close resemblance to the Stott Site remains.

> The sites are of two types, camp areas and burial mounds, neither of which show evidence of horticultural endeavours. On the other hand, there is abundant evidence from both types of sites that the subsistence pattern was oriented around buffalo hunting. Evidence of the first order is manifest by the buffalo offerings placed in the mounds and by its almost exclusive presence as detritus, bone uprights, and implements in the camp areas (Neuman 1975:89).

Sonota sites are present in south central Manitoba, also, especially in the Pembina Valley (Syms 1977:89) and west onto the Plains in Saskatchewan and Alberta.

Oddly enough, traits of Sonota mounds are relatively consistent with those in evidence at the Stott Mound, although more elaborate. Difficulties arise when comparisons are made between the campsite recoveries. In Sonota sites, nearly all of the finely worked lithic tools are fashioned of Knife River Flint. Projectile points are almost universally categorized as Besant or Samantha Corner-Notched; the Mulbach site in Alberta is an excellent example where, despite the distance from the quarries, Knife River Flint predominated among the Besant projectile points (Gruhn 1971). Interestingly enough, at the Stott Site in Area Upper B in 1982, 32% of all the lithic materials recovered were Knife River Flint. In Area F, Swan River Chert was the most frequently utilized stone (44%) and Knife River Flint only totalled 14% (Tables 42 and 43). Because it does appear likely that there is either a Late Initial or Early Terminal Woodland component present in the park, if this component were Sonota, the increase in Knife River Flint would be significant. Unfortunately there are no Besant points at DlMa-1. The specimens termed Stott Corner-Notched are smaller and bear a distinctive outline that is not Besant. Furthermore, although there is also hypothesized Late Initial or Early Terminal Woodland pottery (dentate stamped; dentate stamped and bossed) in the park, these particular vessels bear no resemblance to pottery found in Sonota sites, nor does Sonota pottery resemble any other vessels found at DlMa-1.

Tisdale (Pokotylo and Tisdale 1982) first hypothesized that the dentate stamped pottery from Area Lower B in the park might be associated with St. Croix Stamped pottery distributed through central Minnesota and north along the Red River valley in the Parkland regions of the various states involved and possibly into Manitoba. St. Croix ware has been found at two sites in South Dakota (De Spiegler) and Minnesota (Lake Bronson) incorporated into Arvilla Complex burial mounds (Johnson 1973), although sometimes the Lake Bronson vessel is described as Blackduck.

> The Arvilla burial complex as a consistent, recurring pattern consisting of linear and circular mounds, subsoil burial pits, flexed and disarticulated primary and bundled secondary burials, frequent use of red and yellow ocher, associated utilitarian and ornamental grave goods dominated by bone and shell artifacts, Prairie side-notched and broad side-notched projectile points, blade side-scrapers of brown chalcedony, and mortuary vessels of St. Crois stamped or Blackduck ware is a diagnostic cultural complex.... There are no single traits that are restricted to this complex and that thus become diagnostic of the whole. The flexed, sitting burial mode, for example, is much more widespread in both time and space and is found in the Blackduck culture (Evans 1961), in the log tomb mound pattern of the Missouri River mounds (Neuman 1960), and in many of the Manitoba mounds (Capes 1963) to cite only a few examples. The same could be said for any of the specific individual artifacts or traits in the Arvilla Complex. The particular combination of these traits in this recurrent pattern, however, is distinctive, and it is this consistency within a limited range of variability that makes Arvilla a cultural complex (Johnson 1973:62).

The Arvilla type site consists of three burial mounds located on one of the Glacial Lake Agassiz beach ridges near Turtle River, an eastern flowing tributary of the Red River, north of Arvilla, North Dakota. These mounds were excavated by A.E. Jenks in 1933. Mound 3 contained 13 burials in three subsurface pits -- two holding six individuals each and one a solitary burial. Grave goods in one pit consisted of a copper knife or spear point and a bone arm band. The second pit held two copper crescents and a copper shell-shaped ornament, two modified bear canines and an antler pipe associated with one adult male. As well, three shell beads were also found in this pit in association with another skeleton (Johnson 1973:10-11). Also notable within Mound 3 were "the skulls of two bison and the lower end of the spinal column of a bison" (Johnson 1973:10).

Dates for St. Croix pottery are in the A.D. 500 - 800 range (George 1979:169), while Arvilla dates have been obtained from two sites, De Spiegler in South Dakota and Haarstad in Minnesota. Harstaad dates are A.D. 785 ± 120 (I-778) on human bone and B.C. 1250 ± 190 (I-780) on clam shell. De Spiegler dates are A.D. 600 (I-779) on human bone and A.D. 1280 (I-792) on birch bark (standard deviations were not reported for these last two dates). Johnson chooses to accept the bone dates as valid, but discards the other two.

> ... The dates on human bone from the two sites are consistent. In the 1964 paper reporting them, I pointed out that the bark date was highly suspect because of contamination from grass roots, while the shell date seemed to bear little relationship to anything (Johnson 1973:66).

If Johnson's explanation for the discrepancies can be accepted, then it would appear that the Stott Mound might be affiliated with Arvilla Complex sites. Syms (1979:300) disagrees with Johnson's assessment of Arvilla's chronological placement, however, viewing Arvilla more likely as occurring later in time. He considers the Lake Bronson mortuary vessel a Late Blackduck manifestation in Lugenbeal's terminology, likely falling in the A.D. 1200 - 1400 range.

Obviously no ready answers to these controversies have presented themselves, nor has there been any resolution of the problem of the cultural affiliation of the Stott Mound. It would certainly be useful at this point to have some examples of St. Croix pottery for examination, as well as the mortuary vessels in question, to compare with Stott Site dentate stamped pottery. Although no solutions have been achieved, perhaps the direction in which future research may move has been indicated.

CONCLUSIONS

It is somewhat ironic, of course, that our expanding knowledge and understanding of the Stott Site comes at the price of its destruction. By the nature of the discipline, however, that same price is paid by all archaeological investigations. The number of sites in this province and the costs involved in excavating them prohibit all but the most necessary of salvage operations. The reality of this situation does not necessarily mean, however, that knowledge of our prehistoric heritage will be lost. Surely the safest place for archaeological materials is undisturbed in the ground, while development, expansion and refinement of archaeological skills and techniques proceed as quickly as possible. Conversely, the imminent destruction of valuable sites or those suspected of being important should be preceded by suitable survey and/or excavation.

During the past 40 years, construction, repair and expansion of the TransCanada Highway has been the impetus for most of the archaeological work at DlMa-1, certainly all of that within Grand Valley Provincial Recreation Park and also Area F. With these factors in mind, the following recommendations for excavation and research at DlMa-1 are proposed:

1) a halt to further excavation of a purely research or academic orientation until a multidisciplinary study of all the previously excavated materials has been conducted;

2) an intensive survey of the Assiniboine flood plain under favourable conditions (dry and not in crop), especially of Areas D and E, where the pound is hypothesized to have been located; and

3) a survey of the valley wall west of the TransCanada highway to the juncture of the Little Saskatchewan with the Assiniboine to determine the site's western limits.

In so far as activities of the Department of Highways and Transportation are concerned, the following recommendations are proposed:

1) because cultural materials within Grand Valley Provincial Recreation Park have already been disturbed by construction of the park, and because Area Upper B is considered to have been adequately sampled in 1977, 1981 and 1982, highway construction affecting this portion (Area Upper B) of the site, may proceed unhindered;

2) no construction activities should involve subsurface disturbance of the Stott farm portion of the site. If such activities are deemed absolutely necessary and unalterable, the Historic Resources Branch should have prior approval of construction plans before they are carried out and adequate time in which to conduct the archaeological procedures deemed necessary; and

3) because it has become increasingly obvious that the site boundaries probably extend southeastward to the Assiniboine River, the Historic Resources Branch should be kept informed of any construction activities along the pertinent portions of the TransCanada Highway up to and including the Assiniboine River bridge, so that proper monitoring of the site and excavations may take place as necessary.

ADDENDUM

The construction plans of the Department of Highways and Transportation that immediately threatened the safety of the Stott Site involved the cutting back of the slope on the west side of the TransCanada Highway, as the roadway descends the valley wall onto the Assiniboine River flood plain. The grade of this slope was too steep at this particular location and, consequently, promoted erosion of the embankment (Figure 91). This area had to be stabilized by cutting back the embankment further, only at a lesser degree of slope than previously. Earth removed from this area would be used as fill for construction of a new bridge over the Assiniboine River.

According to procedures agreed upon by the Historic Resources Branch and the Department of Highways and Transportation, the Historic Resources Branch was notified when the proposed construction area had been staked so that potential damage to the site could be assessed. In mid-July of 1983, Barbara Eros and the senior author met with representatives of the Department of Highways and Transportation at the site to inspect the embankment area. Contrary to the original plans, which would have inflicted no damage on undisturbed portions of the site, the staked area had been extended down slope to an elevation of 401 m, thereby affecting a small (75 m^2) triangular-shaped piece of land lying 8 m east of the 1982 Units 102, 103 and 104 (see Figure 92).

After consulting with Steve Zoltai about the value of this specific area, the Department of Highways and Transportation was informed that there were no objections to their plans as long as the Historic Resources Branch received notice when subsurface operations began, so that an archaeologist

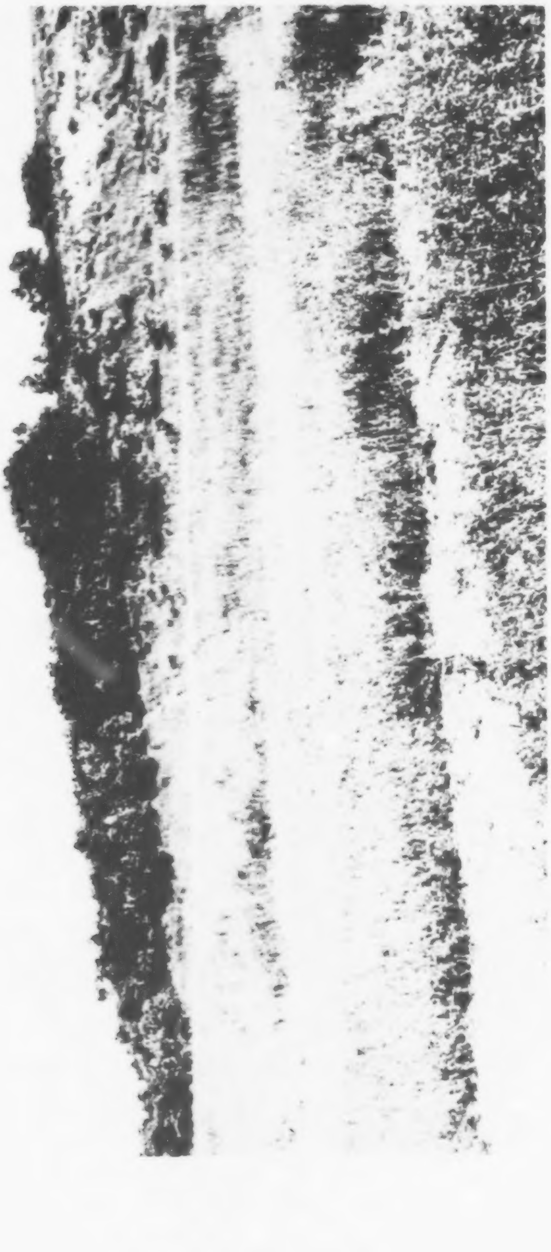
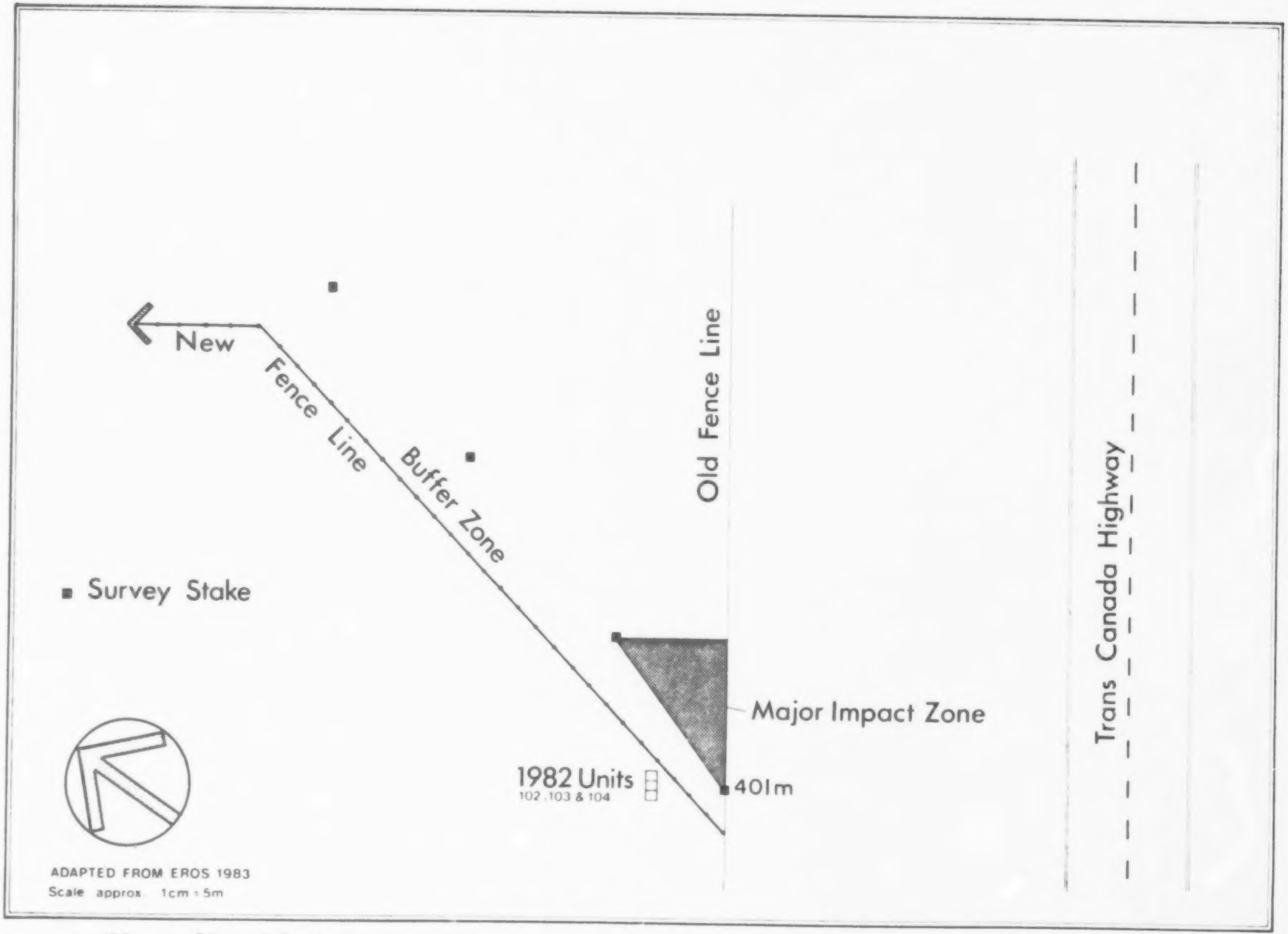


Figure 91. Eroding embankment on west side of TransCanada Highway.


New
Fence Line
Buffer Zone
Old Fence Line
Trans Canada Highway
Survey Stake
Major Impact Zone
1982 Units
102, 103 & 104
401m

ADAPTED FROM EROS 1983
Scale approx. 1cm : 5m

Figure 92. Embankment stabilization on the TransCanada Highway: Stott Site impact area.

could be on site. It was also understood that collections of artifacts would be made at the archaeologist's discretion, even if machinery had to be diverted for a time.

Consequently, in early September, Peter Walker and the senior author returned to the site to monitor construction activities. Entrance to the construction area was gained northeast of the valley wall through a quarter section road used by Glen Stott to access his field. The newly-expropriated portion of the Stott property was to be stripped of its top soil, thereby exposing the sands and gravels beneath, which would be hauled to the Assiniboine River crossing. Heavy machinery would move down the valley wall immediately adjacent to the previously identified impact zone, returning by way of the ditch at the edge of the highway (Figures 93 and 94).

Once the machinery was observed in action, it was gratifying to see that little damage was actually occurring to undisturbed portions of the site. Only two situations were of concern:

1) The triangular-shaped piece of land previously identified as the major impact zone was affected only at its northeastern edge, where it intersected the down slope roadway for the earth moving equipment. Initial plans were to examine the top soil in this small area, which had been pushed aside to the west by the machinery. Cultural materials are located on the valley wall exclusively in this upper soil zone, which was of no interest to the construction engineers. As it wasn't safe to work along the roadway edge with the machinery moving on it, the examination was to be done during breaks in the construction activity. Unfortunately, before this occurred, one machine veered too close to the western edge of the roadway and

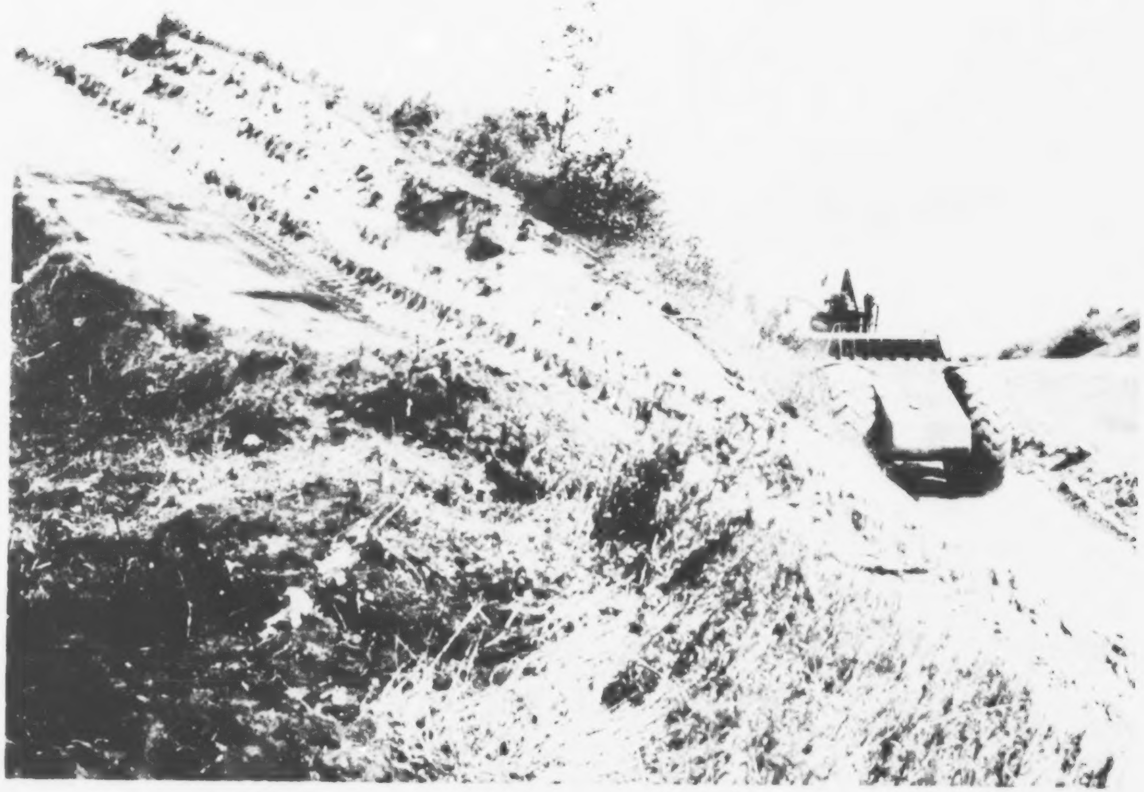
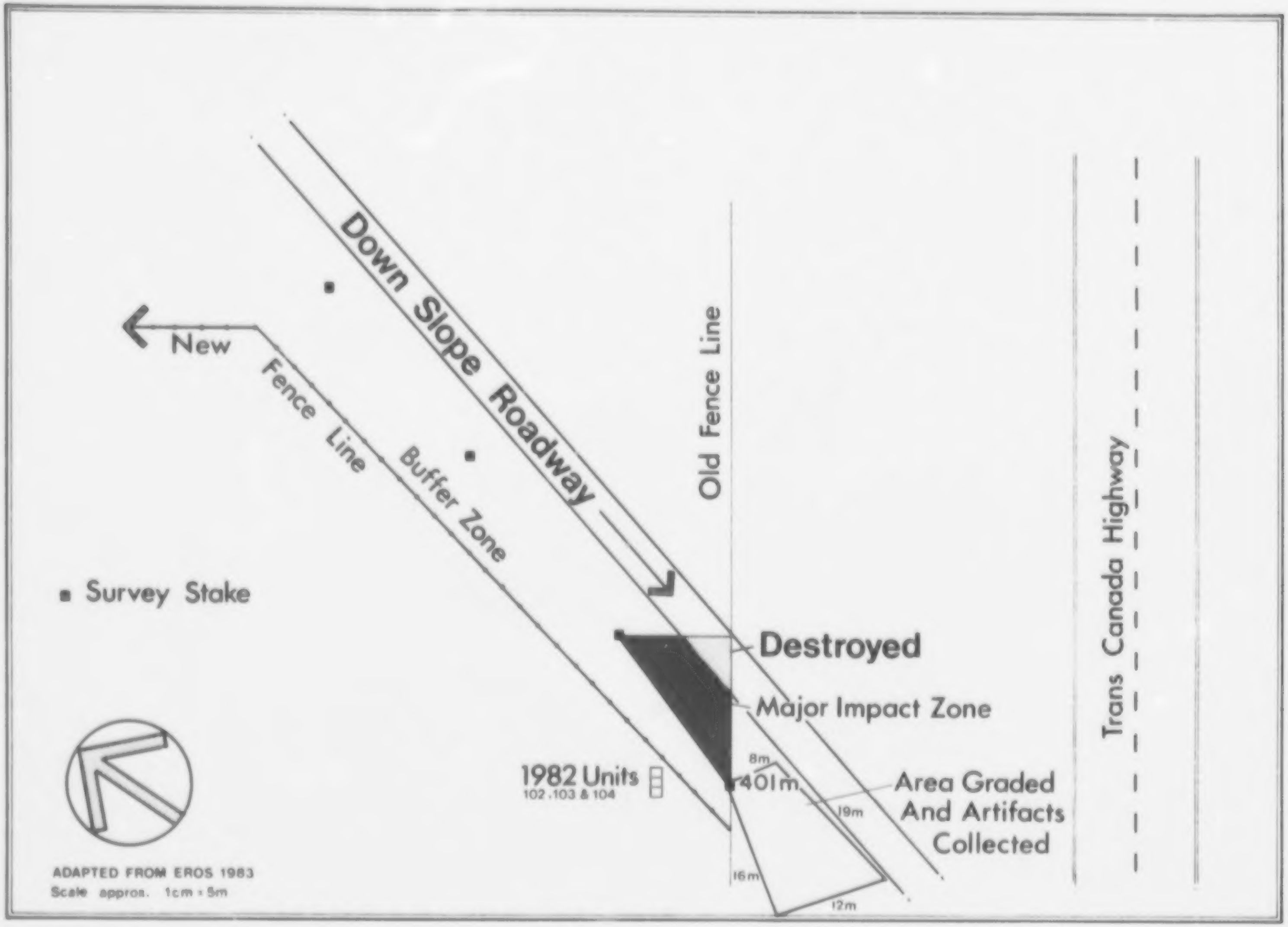


Figure 93. Earth moving equipment at the site.


Down Slope Roadway
New
Fence Line
Buffer Zone
Survey Stake
Old Fence Line
Destroyed
Major Impact Zone
Area Graded
And Artifacts
Collected
1982 Units
102, 103 & 104
401m
8m
19m
16m
12m
Trans Canada Highway

ADAPTED FROM EROS 1983
Scale approx. 1cm = 5m

Figure 94. Embankment stabilization on the TransCanada Highway: Effect on the Stott Site.

scraped away this small area of top soil (see portion marked "destroyed" on Figure 94).

2) The second situation consisted of an irregular rectangular piece of land approximately 170 m^2 in area. It lay below 401 m in elevation and east of the Stott property line (see Figure 94). Its location was mid-terrace and parallel with Unit 125. Heavy concentrations of artifacts had been recovered from this position on the valley wall in 1982 and would likely be present in the similar setting. The area in question had been minimally graded (it was already relatively flat) and, in the process, saplings, shrubs and grasses had been uprooted and pushed to the down slope end of the rectangle. A cursory examination of the loosened soil revealed many bison bones. It was decided to collect the bone and artifacts from this graded region, so the rest of that day and half of another were spent systematically removing cultural materials from the loosened top soil. Trowels were used to move the soil around, but no subsurface excavation was conducted (Figure 95).

Recoveries from the graded area were quite consistent with findings on the 1982 materials. Twenty ceramic sherds, 124 pieces of lithic and 772 bone items were gathered in the area. All of the bone appears to be bison and seems to differ from the 1982 specimens in that it is less broken. This impression, however, may result from a bias in favour of large or whole pieces of bone picked up during the collection process. Several diagnostic lithic and ceramic artifacts were recovered as well.

Of the ceramics, rim sherd F83-1 (Figure 96a) is certainly Blackduck, with oblique cordwrapped object impressions on vessel lip, interior and

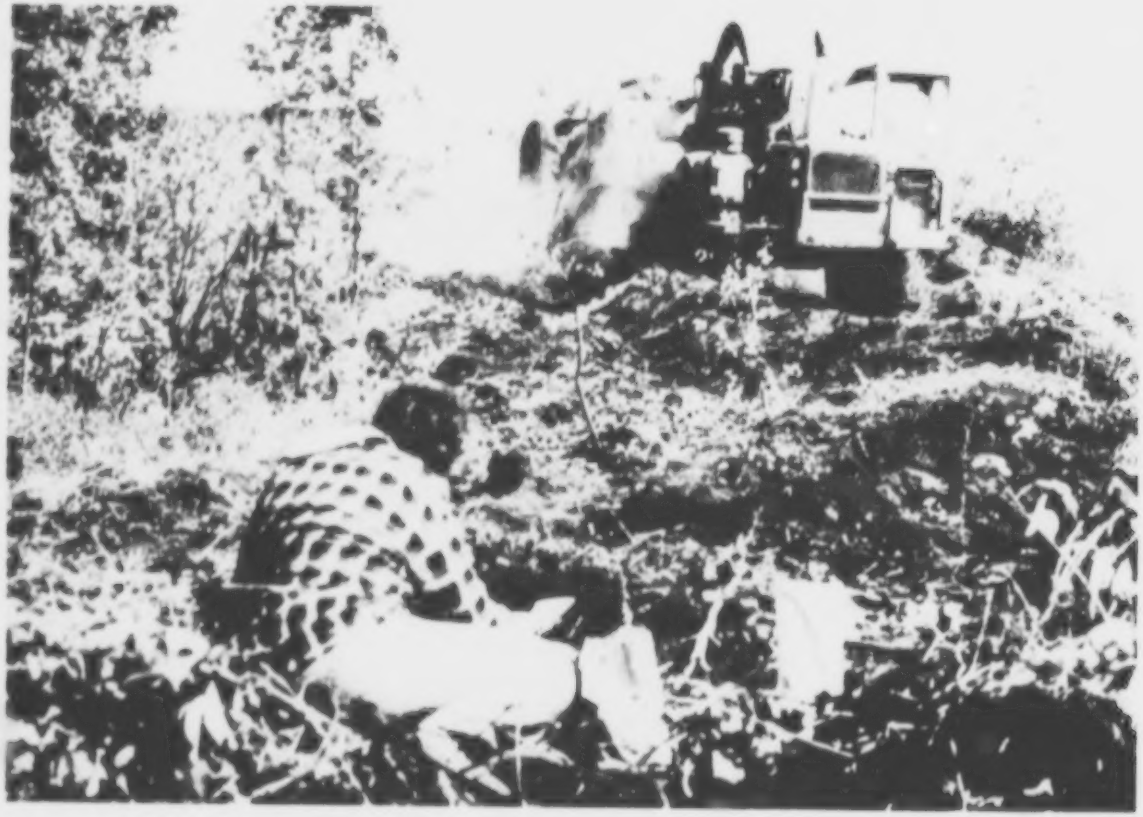


Figure 95. Senior author collecting artifacts during construction.

exterior. Unfortunately the sherd is not large enough to place it more precisely within the modal system. Rim sherd F83-2 (Figure 96b) bears oblique dentate stamps on lip and exterior, as well as a boss on the exterior. It appears identical, including decorative motif, to Vessel 29 from Unit 99 (Figure 54a).

Of the lithic recoveries, projectile point F83-6 (Figure 96c) is not well made, but nevertheless can be placed with little difficulty into the Prairie Side-Notched category. Fine unifaces F83-8 and F83-9 (Figure 96e, d) are also similar to specimens recovered from Area F in 1982; like many of these unifaces, these also are fashioned of Knife River Flint.

To date, no records have been found detailing the amount of archaeological material lost during construction of the TransCanada Highway. Certainly the recovery of so much cultural debris from a location outside the previous Stott property line helps to emphasize the richness of the site and to stress the necessity for co-operative management of the area by the governmental departments whose activities impact it. Hopefully the salvage programme at DlMa-1 in 1983 has been a model for similar projects at the Stott Site and elsewhere in the province where heritage resources are threatened.

Figure 96. Artifacts recovered from construction area in 1983.

(a) Rimsherd F83-1
(b) Rimsherd F83-2
(c) Projectile point F83-6
(d) Uniface F83-9
(e) Uniface F83-8

Figure 96. Artifacts recovered from construction area in 1983.

REFERENCES CITED

Allman, Michael, and David F. Lawrence
1972 Geological Laboratory Techniques. Blandford Press, London.

Arthur, George W.
1978 A Re-Analysis of the Early Historic Plains Indian Bison Drives. Plains Anthropologist, Memoir 14, pp. 236-242.

Badertscher, Patricia M.
1985 The 1977 Investigations at the Aschkibokahn Site (FbMb-1), Duck Bay, Manitoba. MS. on file with Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Bird, Ralph D.
1947 Report on Investigations at Stott Site 1947. MS. on file with Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Bradford, Sheila
1982 Stott Site Field Notes, Unit 102. Ms. on file with the Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Brain, C.K.
1976 Some Principles in the Interpretation of Bone Accumulations Associated with Man. In Human Origins, edited by G.L. Isaac and E.R. McCown, pp. 97-116. Staples Press, Menlo Park, California.

Buol, S.W., F.D. Hole, and R.J. McCracken
1980 Soil Genesis and Classification. 2nd ed. Iowa State University Press, Ames.

Burpee, Lawrence J. (editor)
1908 Journal of Matthew Cocking, from York Factory to the Blackfeet Country, 1772-73. Proceedings and Transactions of the Royal Society of Canada, Third Series, II: May 1908, pp. 89-121.

Canada Soil Survey Committee, Subcommittee on Soil Classification
1978 The Canadian System of Soil Classification. Canada Department of Agriculture Publication 1646, Supply and Services Canada, Ottawa.

Canada-Manitoba Soil Survey
1976 Soils of the Brandon Region Study Area. Soils Report No. 30. Province of Manitoba, Department of Municipal Affairs, Municipal Planning Branch, Winnipeg.

Carmichael, Patrick H.
1977 A Descriptive Summary of Blackduck Ceramics from the Wanipigow Lake Site Area (EgKx-1), 1975 and 1976. Papers in Manitoba Archaeology, Miscellaneous Paper No. 5. Province of Manitoba, Department of Tourism, Recreation and Cultural Affairs, Historic Resources Branch, Winnipeg.

Carver, Robert E. (editor)
1971 Procedures in Sedimentary Petrology. Wylie and Sons, New York.

Crandell, Dwight R.
1968 Mudflow. In Encyclopedia of Geomorphology, edited by R.W. Fairbridge. Reinhold Book Corporation, New York.

Evans, G. Edward
1961 A Reappraisal of the Blackduck Focus of Headwaters Lakes Aspect. Masters thesis, Department of Anthropology, University of Minnesota, Minneapolis.

Fookes, P.G., D.L. Gordon and I.E. Higginbottom
1975 Proceeding of the Symposium Held at the University of Birmingham 21-23rd April, 1975. The Midland Soil Mechanics and Foundation Engineering Society. Department of Civil Engineering, University of Birmingham, Birmingham

Forbis, Richard G.
1962 The Old Women's Buffalo Jump, Alberta. National Museum of Canada Bulletin No. 180, Contributions to Anthropology, Part I: pp. 56-123.

Friedman, Gerald M., and John E. Sanders
1978 Principles of Sedimentology. John Wiley and Sons, New York.

Frison, George C.
1971 The Buffalo Pound in Northwestern Plains Prehistory: Site 48 CA 302, Wyoming. American Antiquity 36 (1): 77-91.

1978 Animal Population Studies and Cultural Inference. Plains Anthropologist, Memoir 14, pp. 44-52.

Fuchtbauer, Hans
1974 Sediments and Sedimentary Rocks 1. Part II. Halsted Press Division, John Wiley and Sons, New York.

Fuller, W.A.
1959 The Horns and Teeth as Indicators of Age in Bison. Journal of Wildlife Management 23 (3): 342-344.

George, Douglas
1979 St. Croix Stamped Series. In A Handbook of Minnesota Prehistoric Ceramics, edited by Scott F. Anfinson, pp. 169-174. Minnesota Archaeological Society, Occasional Publications in Minnesota Anthropology, No. 5, Fort Snelling.

Griffiths, John C.
1967 Scientific Method in Analysis of Sediments. McGraw-Hill Book Company, New York.

Gruhn, Ruth
1971 Preliminary Report on the Muhlbach Site: A Besant Bison Trap in Central Alberta. National Museum of Man of the National Museums of Canada, Bulletin 232, Contributions to Anthropology VII: Archaeology and Physical Anthropology, pp. 128-156.

Hamilton, Scott
1981 1979 Excavations at the Stott Site (DlMa-1) with Interpretations of Cultural Stratigraphy. Papers in Manitoba Archaeology, Miscellaneous Paper No. 12. Province of Manitoba, Department of Cultural Affairs and Historical Resources, Historic Resources Branch, Winnipeg.

Hind, Henry Youle
1971 Narrative of the Canadian Red River Exploring Expedition of 1857 and of the Assiniboine and Saskatchewan Exploring Expedition of 1858. M.G. Hurtig, Edmonton.

Hutchinson, J.N.
1968 Mass Movement. In Encyclopedia of Geomorphology, edited by R.W. Fairbridge, Reinhold Book Corporation, New York.

James, Edwin (editor)
1956 A Narrative of the Captivity and Adventures of John Tanner (U.S. Interpreter at the Saut de Ste. Marie) during Thirty Years Residence among the Indians in the Interior of North America. Ross & Haines, Minneapolis.

Johnson, Elden
1973 The Arvilla Complex. Minnesota Historical Society, Minnesota Prehistoric Archaeology Series No. 9, St. Paul.

Joyes, Dennis C.
1969 The Avery Site at Rock Lake: A Prehistoric Campsite in Southwestern Manitoba. Master's thesis, Department of Anthropology, University of Manitoba, Winnipeg.

Kehoe, Thomas F.
1966 The Small Side-Notched Point System of the Northern Plains. American Antiquity 31 (6):827-841.

1967 The Boarding School Bison Drive Site. Plains Anthropologist, Memoir 4.

1973 The Gull Lake Site: A Prehistoric Bison Drive Site in Southwestern Saskatchewan. Publications in Anthropology and History No. 1, Milwaukee Public Museum, Milwaukee.

Klassen, R.W.

1972 Wisconsin Events and the Assiniboine and Qu'Appelle Valleys of Manitoba and Saskatchewan. *Canadian Journal of Earth Sciences* 9:544-560.

1984 *Assiniboine Delta and the Assiniboine-Qu'Appelle Valley System: Implications Concerning the History of Lake Agassiz in Southwestern Manitoba*. Geological Survey of Canada, Ottawa, in press.

Koch, Walker

1935 The Age Order of Epiphyseal Union in the Skeleton of the European Bison (*Bos bonasus L.*). *The Anatomical Record* 61:371-376.

Lugenbeal, Edward Norman

1976 The Archeology of the Smith Site: A Study of the Ceramics and Culture History of Minnesota Laurel and Blackduck. Ph.D. dissertation, Department of Anthropology, University of Wisconsin, Madison.

1979 Blackduck Ware. In *A Handbook of Minnesota Prehistoric Ceramics*, edited by Scott F. Anfinson, pp. 23-37. Minnesota Archaeological Society, Occasional Publications in Minnesota Anthropology No. 5, Fort Snelling.

MacNeish, Richard S.

1954 The Stott Mound and Village, Near Brandon, Manitoba. *Annual Report of the National Museum of Canada, 1952-1953*, Bulletin 132, pp. 20-65. Ottawa.

MacPherson, A.M.

1954 Letter to William Morton, May 9, 1954. Provincial Archives of Manitoba, Winnipeg.

Letter to William Morton, October 29, 1954. Provincial Archives of Manitoba, Winnipeg.

Morgan, R. Grace

1979 *An Ecological Study of the Northern Plains as Seen through the Garratt Site*. University of Saskatchewan, Department of Anthropology, Occasional Papers in Anthropology No. 1, Regina.

Morton, William

1954 Letter to A.M. MacPherson, November 9, 1954. Provincial Archives of Manitoba, Winnipeg.

Muller, German

1967 *Methods in Sedimentary Petrology*. Part 1. Hefner Publishing Company, New York.

Neuman, Robert W.

1975 *The Sonota Complex and Associated Sites on the Northern Great Plains*. Nebraska State Historical Society, Lincoln.

Nicholson, B.A.
1976 A Study of Projectile Point Typology at the Stott Site (DlMa-1) and Some Observations on Basal Attrition. Archaeology in Montana 17 (1 & 2):53-81.

Nielsen, Erik
n.d. Sediment Analysis. Province of Manitoba, Department of Natural Resources, Geological Services Branch, Winnipeg.

Olsen, Stanley J.
1974 Post-Cranial Skeletal Characters of Bison and Bos. Reprinted by Kraus Reprint Company. Originally published 1960, Peabody Museum of Archaeology and Etnnology, Cambridge, Massachusetts.

Pokotylo, David, and Mary Ann Tisdale
1982 Report of the 1981 Excavations at the Stott Site. Ms. on file with the Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Price, Larry W.
1972 The Periglacial Environment, Permafrost, and Man. Commission on College Geography, Resource Paper No. 14. Association of American Geographers. Washington, D.C.

Reeves, Brian
1970 Cultural Dynamics in the Manitoba Grasslands 1000 B.C. - A.D. 700. In Ten Thousand Years: Archaeology in Manitoba, edited by Walter M. Hlady, pp. 153-174. Manitoba Archaeological Society, Winnipeg.

Reher, Charles A.
1970 Appendix II: Population Dynamics of the Glenrock Bison bison population. In The Glenrock Buffalo Jump, 4800304, Late Prehistoric Period Buffalo Procurement and Butchering on the Northwestern Plains, by George C. Frison. Plains Anthropologist, Memoir 7, pp. 51-55.

1973 Appendix II: The Wardell Bison bison Sample: Population Dynamics and Archaeological Interpretation. In The Wardell Buffalo Trap, 48SU301: Communal Procurement in the Upper Green River Basin, Wyoming, by George C. Frison. Anthropological Papers of the Museum of Anthropology, University of Michigan 48:39-105.

1974 Population Study of the Casper Site Bison. In The Casper Site: A Hell Gap Bison Kill on the High Plains, edited by George C. Frison, pp. 113-124. Academic Press, New York.

Roberts, Linda J.
1982 The Formulation and Application of a Technique, Based on Phalanges, for Discriminating the Sex of Plains Bison (Bison bison bison). Master's thesis, Department of Anthropology, University of Manitoba, Winnipeg.

Saylor, Barbara

1976 The 1975 Stott Site Field School Excavations: End of Season Report. *Archae-Facts: Journal of the Archaeological Society of South-Western Manitoba* 4(1):1-8.

Semenov, S.A.

1964 *Prehistoric Technology*. Cory, Adams & Mackay, London.

Sharpe, C.F. Stewart

1960 *Landslides and Related Phenomena*. Pageant Books, Patterson, New Jersey.

Stoltman, James B.

1973 *The Laurel Culture in Minnesota*. Minnesota Prehistoric Archaeology Series No. 8, Minnesota Historical Society, St. Paul.

Syms, Leigh

1972 The 1971 Field Season in the Southwestern Manitoba Research Area. A Preliminary Report Submitted to the National Museum of Man. Unpublished MS in the author's possession.

1976 Radiocarbon Dates from the Stott Site (DlMa-1), Manitoba. *Archae-Facts: Journal of the Archaeological Society of South-Western Manitoba*. 4(2):28-33.

1977 *Cultural Ecology and Ecological Dynamics of the Ceramic Period in Southwestern Manitoba*. Plains Anthropologist Memoir 12.

1978 *Aboriginal Mounds in Southern Manitoba: An Evaluative Overview*. MS submitted to Parks Canada, Western Region, Winnipeg.

1979 The Devils Lake-Sourisford Burial Complex on the Northwestern Plains. *Plains Anthropologist*, 24-86:283-308.

1980 Radiocarbon Samples Submitted to Radiocarbon Dating Laboratory, Saskatoon, 1971-9. Unpublished MS on file, Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Syms, E. Leigh, Nancy Childs, Susan McIntrye, Catherine Charette, Eric Simonds, and Linda Blachford

1979 Preliminary Reports of the Archaeological Field School Excavations at the Stott Site, 1979. Unpublished MS, Department of Sociology and Anthropology, Brandon University, Brandon.

Tisdale, Mary Ann

1978 *Investigations at the Stott Site: A Review of Research from 1947 to 1977*. Papers in Manitoba Archaeology, Final Report No. 5. Province of Manitoba, Department of Tourism and Cultural Affairs, Historic Resources Branch, Winnipeg.

Tisdale, Mary Ann
1981 Stott Site Field Notes, Unit 87. Ms. on file with the Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

Tucker, M.E.
1981 *Sedimentary Petrology: An Introduction*. John Wiley and Sons, New York.

Umfreville, Edward
1954 *The Present State of Hudson's Bay Containing a Full Description of That Settlement, and the Adjacent Country; and Likewise of the Fur Trade with Hints for Its Improvement, etc. etc.* Ryerson Press, Toronto.

Watrall, Charles R.
1976 The Stott Site: 1976 Field Report. *Archae-Facts* 4(2):24-27.

Wettlaufer, Boyd
1955 *The Mortlach Site in the Besant Valley of Central Saskatchewan.* Province of Saskatchewan, Department of Natural Resources, Anthropological Series No. 1, Regina.

Wheat, Joe Ben
1978 Olsen-Chubbuck and Jurgens Sites: Four Aspects of Paleo-Indian Bison Economy. In Bison Procurement and Utilization: A Symposium, Leslie B. Davis and Michael Wilson, editors. *Plains Anthropologist*, Memoir 14, pp. 84-89.

Williams, Peter J.
1982 *The Surface of the Earth: An Introduction to Geotechnical Science.* Longman, New York.

Zywina, Michael
1982 Stott Site Field Notes, Unit 125. Ms. on file with the Historic Resources Branch, Manitoba Culture, Heritage and Recreation, Winnipeg.

APPENDIX I
CERAMIC RECOVERIES

A. AREA F

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
ON 104E (99)	1	0	0	0	0	9	9
	2	1	0	0	0	14	15
	3	2	0	0	0	29	31
	4	0	1	0	0	13	14
	5	0	0	0	0	6	6
	6	0	0	0	1	14	15
	7	0	1	0	1	9	11
	8	0	0	0	0	7	7
	9	0	0	0	0	7	7
	10	0	0	0	0	2	2
	11	0	0	0	0	2	2
	12	0	0	0	0	2	2
	16	1	0	0	0	1	2
TOTAL		4	2	0	2	115	123
Balk ON 104/ 105E (100)	1	0	0	0	2	34	36
	2	1	0	0	0	7	8
	3	1	0	0	0	6	7
	4	0	0	0	0	8	8
	6	0	0	0	0	2	2
TOTAL		2	0	0	2	57	61
ON 105E (100)	1	0	0	0	0	7	7
	2	1	0	1	1	7	10
	3	0	1	0	0	9	10
	4	2	0	0	0	38	40
	5	0	0	0	0	15	15
	6	0	0	0	0	10	10
	7	0	0	0	1	15	16
	8	1	1	0	0	4	6
	9	0	0	0	0	1	1
	10	0	0	0	0	2	2
TOTAL		4	2	1	2	108	117

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
Balk ON 105/	1	1	0	0	0	6	7
106E	2	1	1	0	0	11	13
(101)	3	0	0	0	0	1	1
TOTAL		2	1	0	0	18	21
ON 106E	1/2	1	0	0	0	10	11
(101)	3	0	0	0	0	8	8
	4	0	1	0	1	16	18
	5	1	1	0	0	12	14
	6	1	0	0	0	16	17
	7	2	0	0	0	10	12
	8	0	0	0	0	3	3
	9	0	0	0	0	1	1
TOTAL		5	2	0	1	76	84
8S 93E	1	4	0	0	4	75	83
(125)	2	0	0	0	1	9	10
	3	0	0	0	3	14	17
	4	0	1	0	3	22	26
	5	0	1	0	0	6	7
	6	0	0	0	0	13	13
	7	0	0	0	0	1	1
	8	0	0	0	0	3	3
	9	0	0	0	0	1	1
TOTAL		4	2	0	11	144	161
ON 125E (103)	2	0	0	0	1	0	1
TOTAL		0	0	0	1	0	1
1S 125E	1	0	0	1	0	1	2
(102)	2	1	0	0	0	5	6
	3	0	0	0	0	1	1
	4	0	0	0	0	2	2
	5	0	0	0	0	3	3
	6	0	0	0	2	1	3
TOTAL		1	0	1	2	13	17

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
2S 125E (104)	1	0	0	0	0	5	5
	2	0	0	0	1	5	6
	3	0	0	0	0	2	2
	4	0	0	0	0	3	3
	6	0	0	0	0	1	1
	10	0	0	1	0	0	1
TOTAL		0	0	1	1	16	18
1S 125E Feature 2 (102)	3	1	0	0	0	0	1
	5	0	0	0	1	0	1
	7	0	0	0	0	1	1
TOTAL		1	0	0	1	1	3

B. AREA UPPER B

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
4S 40W (116)	7	0	0	0	0	1	1
	9	0	0	0	0	1	1
	15	0	0	0	0	1	1
TOTAL		0	0	0	0	3	3
5S 40W (115)	3	0	0	0	0	1	1
	5	0	0	0	0	1	1
	6	0	0	0	0	2	2
	7	0	0	0	0	1	1
	10	0	0	0	0	1	1
	12	0	0	0	0	1	1
TOTAL		0	0	0	0	7	7
6S 40W (114)	11	1	0	0	0	0	1
TOTAL		1	0	0	0	0	1

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
7S 40W (113)	2	0	0	0	0	1	1
	5	0	0	0	0	1	1
	6	0	0	0	0	1	1
	7	0	0	0	0	2	2
	8	0	0	0	0	1	1
	9	0	0	0	0	1	1
TOTAL		0	0	0	0	7	7
8S 40W (112)	2	0	1	0	0	0	1
	4	0	0	0	0	1	1
	6	0	0	0	0	1	1
	7	0	0	0	0	1	1
	8	0	0	0	0	1	1
	9	0	0	0	0	1	1
	10	0	0	0	0	1	1
	11	0	0	0	0	3	3
TOTAL		0	1	0	0	9	10
9S 40W (111)	8	0	0	0	0	1	1
	10	0	0	0	0	2	2
	11	0	0	0	0	1	1
	12	0	0	0	0	1	1
TOTAL		0	0	0	0	5	5
15S 46W (118)	2	0	0	0	0	2	2
	3	0	0	0	0	1	1
	4	0	0	0	0	1	1
	5	0	0	0	0	3	3
	6	0	0	0	1	10	11
	7	1	0	0	0	6	7
	8	0	1	0	0	10	11
	9	0	0	0	0	5	5
	10	0	0	0	0	2	2
	11	0	0	0	0	1	1
	14	0	0	0	0	2	2
TOTAL		1	1	0	1	43	46

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
15S 47W (117)	1	0	0	0	0	1	1
	3	0	0	0	1	0	1
	4	0	0	0	0	1	1
	5	0	0	0	1	4	5
	6	0	1	0	0	9	10
	7	1	0	0	1	11	13
	8	1	0	0	1	10	12
	9	1	0	0	2	8	11
	10	0	0	0	1	3	4
TOTAL		3	1	0	7	47	58
Balk 15S 46/ 47W (118)	2/3	0	0	0	0	2	2
	2/4	1	1	0	0	2	4
	3/7	0	0	0	0	1	1
	3/8	0	0	0	0	1	1
TOTAL		1	1	0	0	6	8
46S 25W (119)	3	0	0	0	0	1	1
	6	0	0	0	0	1	1
	9	0	0	0	0	1	1
	10	0	0	0	0	2	2
	2/2	0	0	0	0	1	1
TOTAL		0	0	0	0	6	6
46S 26W (120)	4	0	0	0	0	1	1
	5	0	0	0	0	3	3
	6	0	0	0	0	2	2
	7	0	0	0	0	4	4
	8	0	0	0	0	1	1
	2/2	0	0	0	0	1	1
	2/3	0	0	0	0	1	1
	3/1	0	0	0	0	1	1
TOTAL		0	0	0	0	14	14
46S 27W (121)	2	0	0	0	0	1	1
	3	0	0	0	0	1	1
	5	0	0	0	0	1	1
	7	0	0	0	0	2	2
	9	0	0	0	0	1	1
TOTAL		0	0	0	0	6	6

UNIT	LEVEL	RIM	NECK	SHOULDER	DECORATED BODY	BODY	TOTAL
47S 25W	2	0	0	0	0	1	1
(122)	4	0	0	0	0	1	1
	5	1	0	0	0	3	4
	6	1	0	0	1	5	7
	7	0	0	0	0	1	1
	8	0	0	0	0	1	1
	9	0	0	0	0	1	1
	2/2	0	0	0	0	1	1
TOTAL		2	0	0	1	14	17
47S 26W	4	0	0	0	0	2	2
(123)	5	0	0	0	0	1	1
	6	0	0	0	0	4	4
	7	0	0	0	0	3	3
	8	0	0	0	0	1	1
	9	0	0	0	0	1	1
TOTAL		0	0	0	0	12	12
47S 27W	3	0	0	0	1	1	2
(124)	5	0	0	0	0	2	2
	6	0	0	0	0	3	3
	8	0	0	0	0	1	1
TOTAL		0	0	0	1	7	8

APPENDIX II
CERAMIC ATTRIBUTES

A. ATTRIBUTE LIST AND CODE FOR UNDECORATED BODY SHERDS[1]

1. Surface Treatment

    a. Cord roughened, not cord marked
    b. Cord marked, paddled
    c. Smoothed
    o. Unidentifiable

[1] Adapted from Lugenbeal 1976, Table 95, p. 743

B. ATTRIBUTE LIST AND CODE FOR RIM SHERDS[2]

1. Lip Shape

    a. Beveled-out
    b. Beveled-in
    c. Symmetrical
    d. Pointed
    o. Unidentifiable

2. Interior Rim Decoration

    a. Cordwrapped stick
    b. Horizontal brush
    c. Punctated
    d. Dentate stamp
    e. No decoration
    o. Unidentifiable

3. Lip Decorative Motifs

    a. Oblique
    b. Horizontal
    c. Herringbone
    d. Cross-hatch
    e. Zig-zag
    f. Vertical
    o. Unidentifiable

4. Exterior Decoration (Rim-Upper Neck)

   a. Cordwrapped object impressions
   b. Punctations only
   c. CWOI and Punctations
   d. CWOI and Bosses
   e. Dentate Stamp and Bosses
   f. Incisions
   g. No decoration
   o. Unidentifiable

5. Exterior Decorative Motif of Stamped Vessels (excluding punctates and bosses from motif)

   a. Oblique/Horizontal
   b. Oblique (single row)
   c. Horizontal only
   d. Oblique/Horizontal, interrupted
   e. Herringbone Oblique/Horizontal
   f. Complex Banded
   g. Vertical/Horizontal
   h. Undecorated or punctates only
   o. Unidentifiable

6. Use of Bosses and Punctations (Rim-Upper Neck)

   a. Punctations
   b. Bosses
   c. No Punctations or Bosses
   o. Unidentifiable

7. Type of Punctations (Rim-Upper Neck)

   a. Circular
   b. Noncircular
   c. Combination

8. Spacing of Punctations (Rim-Upper Neck)

   a. Spaced (5 mm or more)
   b. Close (4 mm or less)
   c. Combination
   d. Zoned
   e. No punctations
   o. Unidentifiable

9. Relationship of Bosses and Punctations to Motif (Rim-Upper Neck)

   a. Superimposed
   b. Part of motif
   c. Below motif
   d. Above motif
   e. Bosses or punctations alone
   f. Unidentifiable

10. Brushing - Exterior
    - a. Present
    - b. Absent
    - o. Unidentifiable

11. Type of Cordwrapped Object Impressions
    - a. Twisted cord
    - b. Pseudo-cord
    - c. Paddle edge heavy cord
    - d. Vessels lacking CWS

12. Rim-Neck Surface Treatment
    - a. Smoothed
    - b. Cord-marked
    - c. Fabric-marked
    - d. Brushed

[2] Adapted from Lugenbeal 1976, Table 95, p. 745

C. ATTRIBUTE LIST AND CODE FOR DECORATED BODY SHERDS[3]

1. Cordwrapped Stick
    - a. Present
    - b. Absent

2. Type of Cordwrapped Stick
    - a. Twisted
    - b. Pseudo
    - c. Paddle Edge

3. Brushing
    - a. Present
    - b. Absent

4. Bosses and Punctations
    - a. Punctations Present
    - b. Bosses Present
    - c. Neither Present

5. Type of Punctations
    a. Circular Spaced
    b. Indentations
    c. Combinations
6. Punctation Frequency
    a. Single Row
    b. Multiple Row

3 Adapted from Lugenbeal 1976, Table 95, p. 743

APPENDIX III
CERAMIC DATA

A1. UNDECORATED BODY SHERDS - AREA F

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%[a]	#	%	#	%	#	%
ON 104E	1	9					3	2.61	6	5.22
(99)	2	14	4	3.48			1	.87	9	7.83
	3	29	17	14.78	1	.87	2	1.74	9	7.83
	4	13	3	2.61			2	1.74	8	6.96
	5	6	2	1.74			2	1.74	2	1.74
	6	14	8	6.96			1	.87	5	4.35
	7	9	6	5.22					3	2.61
	8	7	3	2.61	2	1.74			2	1.74
	9	7	3	2.61	1	.87			3	2.61
	10	2	1	.87					1	.87
	11	2	1	.87					1	.87
	12	2	2	1.74						
	16	1							1	.87
		115	50	43.48	4	3.48	11	9.57	50	43.48
Balk										
ON 104	1	34	9	15.79	4	7.02			21	36.84
/105E	2	7	4	7.02			3	5.26		
(100)	3	6	4	7.02					2	3.51
	4	8	3	5.26			1	1.75	4	7.02
	6	2							2	3.51
		57	20	35.09	4	7.02	4	7.02	29	50.88

A1. UNDECORATED BODY SHERDS - AREA F

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%	#	%	#	%	#	%
ON 105E (100)	1	7	5	4.63			2	1.85		
	2	7	5	4.63					2	1.85
	3	9	4	3.70	1	.93	1	.93	3	2.78
	4	38	9	8.33	1	.93	1	.93	27	25.00
	5	15	8	7.41					7	6.48
	6	10	8	7.41	1	.93	1	.93		
	7	15	12	11.11					3	2.78
	8	4	3	2.78			1	.93		
	9	2	1	.93					1	.93
	10	1	1	.93						
		108	56	51.85	3	2.78	6	5.56	43	39.81
Balk ON 105/ 106E (101)	1	6	3	16.67					3	16.67
	2	11	4	22.22	1	5.56			6	33.33
	3	1	1	5.56						
		18	8	44.44	1	5.56	0	0	9	50.00
ON 106E (101)	1/2	10	8	10.53			1	1.32	1	1.32
	3	8	7	9.21	1	1.32				
	4	16	6	7.89	2	2.63			8	10.53
	5	12	8	10.53	1	1.32	1	1.32	2	2.63
	6	16	8	10.53	2	2.63			6	7.89
	7	10	5	6.58					5	6.58
	8	3	2	2.63					1	1.32
	9	1							1	1.32
		76	44	57.89	6	7.89	2	2.63	24	31.58
8S 93E (125)	1	75	19	13.19	1	.69	3	2.08	52	36.11
	2	9	6	4.17			1	.69	2	1.39
	3	14	10	6.94					4	2.78
	4	22	10	6.94	1	.69			11	7.64
	5	6	2	1.39					4	2.78
	6	13	9	6.25					4	2.78
	7	1	1	.69						
	8	3	1	.69					2	1.39
	9	1	1	.69						
		144	59	40.97	2	1.39	4	2.78	79	54.86

A1. UNDECORATED BODY SHERDS - AREA F

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%	#	%	#	%	#	%
1S 125E	1	1	1	7.69						
(102)	2	5	4	30.77			1	7.69		
	3	1							1	7.69
	4	2	2	15.38						
	5	3	3	23.08						
	6	1	1	7.69						
		13	11	84.62	0	0	1	7.69	1	7.69
2S 25E	1	5	4	25.00					1	6.25
(104)	2	5	4	25.00			1	6.25		
	3	2	2	12.50						
	4	3	3	18.75						
	6	1							1	6.25
		16	13	81.25	0	0	1	6.25	2	12.50
Feature 2 (102)	7	1	1	100.00	0	0	0	0	0	0

---

[a] Each percentage was calculated individually and rounded off to the nearest .00. Consequently, in some cases, the total found in per cent column does not equal the sum of its constituent percentages.

A2. UNDECORATED BODY SHERDS - AREA UPPER B

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%^{a}	#	%	#	%	#	%
4S 40W (116)	7	1	1	33.33						
	9	1					1	33.33		
	15	1	1	33.33						
		3	2	66.66	0	0	1	33.33	0	0
5S 40W (115)	3	1	1	14.29						
	5	1			1	14.29				
	6	2	1	14.29	1	14.29				
	7	1			1	14.29				
	10	1	1	14.29						
	12	1	1	14.29						
		7	4	57.14	3	42.86	0	0	0	0
7S 40W (113)	2	1	1	14.29						
	5	1	1	14.29						
	6	1							1	14.29
	7	2	2	28.57						
	8	1	1	14.29						
	9	1	1	14.29						
		7	6	85.71	0	0	0	0	1	14.29
8S 40W (112)	4	1			1	11.11				
	6	1	1	11.11						
	7	1					1	11.11		
	8	1	1	11.11						
	9	1							1	11.11
	10	1	1	11.11						
	11	3	2	22.22					1	11.11
		9	5	55.55	1	11.11	1	11.11	2	22.22

A2. UNDECORATED BODY SHERDS - AREA UPPER B

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%	#	%	#	%	#	%
9S 40W	8	1	1	20.00						
(111)	10	2	1	20.00					1	20.00
	11	1	1	20.00						
	12	1	1	20.00						
		5	4	80.00	0	0	0	0	1	20.00
15S 46W	2	2	1	2.33					1	2.33
(117)	3	1	1	2.33						
	4	1	1	2.33						
	5	3							3	6.98
	6	10	6	13.95	2	4.65	1	2.33	1	2.33
	7	6	5	11.63					1	2.33
	8	10	5	11.63			2	4.65	3	6.98
	9	5	5	11.63						
	10	2	2	4.65						
	11	1	1	2.33						
	14	2	1	2.33					1	2.33
		43	28	65.12	2	4.65	3	6.98	10	23.26
Balk										
15S 46	2/3	2	2	33.33						
/47W	2/4	2	2	33.33						
(117)	3/7	1	1	16.66						
	3/8	1	1	16.66						
		6	6	99.99	0	0	0	0	0	0
15S 47W	1	1			1	2.13				
(118)	4	1	1	2.13						
	5	4	3	6.38	1	2.13				
	6	9	7	14.89	1	2.13			1	2.13
	7	11	4	8.51	3	6.38			4	8.51
	8	10	8	17.02	1	2.13			1	2.13
	9	8	8	17.02						
	10	3	1	2.13	1	2.13			1	2.13
		47	32	68.09	8	17.02	0	0	7	14.89

A2. UNDECORATED BODY SHERDS - AREA UPPER B

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%	#	%	#	%	#	%
46S 25W (119)	3	1			1	16.66				
	6	1	1	16.66						
	9	1	1	16.66						
	10	2	2	33.33						
	Balk 2/2	1	1	16.66						
		6	5	83.33	1	16.66	0	0	0	0
46S 26W (120)	4	1	1	7.14						
	5	3	1	7.14			1	7.14	1	7.14
	6	2	2	14.29						
	7	4	2	14.29			2	14.29		
	8	1	1	7.14						
	Balk 2/2	1	1	7.14						
	2/3	1	1	7.14						
	3/1	1					1	7.14		
		14	9	64.29	0	0	4	28.57	1	7.14
46S 27W (121)	2	1	1	16.66						
	3	1	1	16.66						
	5	1	1	16.66						
	7	2	2	33.33						
	9	1	1	16.66						
		6	6	99.99	0	0	0	0	0	0
47S 25W (122)	2	1			1	7.14				
	4	1					1	7.14		
	5	3	1	7.14					2	14.29
	6	5					1	7.14	4	28.57
	7	1	1	7.14						
	8	1					1	7.14		
	9	1	1	7.14						
	Balk 2/2	1					1	7.14		
		14	3	21.43	1	7.14	4	28.57	6	42.86

A2. UNDECORATED BODY SHERDS - AREA UPPER B

UNIT	LEVEL	TOTAL BODY SHERDS	CORDMARKED PADDLED		CORD-ROUGHENED (NOT MARKED)		SMOOTHED		NOT ID	
			#	%	#	%	#	%	#	%
47S 26W	4	2							2	16.66
(123)	5	1	1	8.33						
	6	4	2	16.66					2	16.66
	7	3	1	8.33			2	16.66		
	8	1							1	8.33
	9	1	1	8.33						
		12	5	41.66	0	0	2	16.66	5	41.66
47S 27W	3	1	1	14.29						
(124)	5	2	1	14.29					1	14.29
	6	3					2	28.57	1	14.29
	8	1							1	14.29
		7	2	28.57	0	0	2	28.57	3	42.86

---

[a] Each percentage was calculated individually and rounded off to the nearest .00. Consequently, in some cases, the total found in the per cent column does not equal the sum of its constituent percentages.

APPENDIX III
CERAMIC DATA

B1. RIM SHERDS - AREA F

ATTRIBUTES	1	2	3	4	5	6	7	8	9	10	11	12
Rim Sherd												
99-43	C[1]	E	A	B	H	A	B	B	E	B	A	B
99-83A	C	E	O	A	H	O	O	O	O	O	O	A
99-84	B	D	A	E	A	B	N/A[2]	E	A	B	N/A	A
99-344	A	E	A	B	H	A	B	O	E	B	B	A
100-466	O	O	A	O	O	O	O	O	O	O	B	O
100-485	A	E	A	C	C	B	O	O	A	B	A	B
100-42	C	E	N/A	B	H	A	B	O	E	B	N/A	A
100-114	A	O	A	A	B	C	N/A	E	N/A	B	A	A
100-17	A	A	A	C	B	A	A	A	C	A	A	D
100-322	A	E	D	A	A	C	N/A	E	N/A	B	B	A
101-281	A	O	A	A	B	C	N/A	E	N/A	B	C	B
101-293	A	B	F	C	B	A	A	O	C	A	A	D
101-12	C	E	A	E	G	B	N/A	E	A	B	N/A	A
101-122	A	E	A	G	H	C	N/A	E	N/A	B	A	B
101-173	C	A	A	C	B	A	A	O	C	B	C	A
101-212	A	D	A	E	A	B	N/A	E	B	B	N/A	A
101-213	A	A	A	C	G	A	A	A	A	B	A	B
125-31	A	O	F	D	A	B	N/A	E	A	B	A	B
125-31A	O	E	A	O	O	O	O	O	O	O	O	O
125-29	A	E	A	C	A	A	A	A	A	B	B	A
125-30	A	E	A	C	B	A	B	O	C	A	C	D
102-19	C	E	A	F	A	C	N/A	E	N/A	B	N/A	A
102-45	A	E	C	A	B	C	N/A	E	N/A	B	B	A

[1] See Appendix IIB for details of rim sherd attributes.
[2] N/A = Attribute not applicable to this rim sherd.

APPENDIX III
CERAMIC DATA

B2. RIM SHERDS - AREA UPPER B

ATTRIBUTES	1	2	3	4	5	6	7	8	9	10	11	12
Rim Sherd												
114-50	B[1]	0	A	0	0	0	0	0	0	0	B	0
118-53	C	E	A	G	H	C	N/A[2]	E	N/A	B	C	B
117-71	A	B	A	A	B	C	N/A	E	N/A	B	B	A
117-103	B	E	A	C	B	A	A	A	C	B	A	B
117-124	C	E	N/A	B	H	A	A	A	E	A	D	D
118-118	B	E	A	A	B	C	N/A	E	N/A	A	B	0
122-23	C	A	F	C	G	A	B	A	A	B	A	A
122-33	B	E	F	C	G	A	A	A	A	B	A	A

[1] See Appendix IIB for details of rim sherd attributes.
[2] N/A = Attribute not applicable to this rim sherd.

APPENDIX III
CERAMIC DATA

C1 DECORATED BODY SHERDS - AREA F

SHERD	CATALOGUE NUMBER	ATTRIBUTES[1]					
		1	2	3	4	5	6
1	99-118	A	A	B	A	B	B
2	99-234A	B	N/A[2]	B	C	N/A	N/A
3	99-280/281	A	0[3]	B	A	B	A
4	99-280	A	B	B	C	N/A	N/A
5	100-394a	B	N/A	B	C	N/A	N/A
6	100-394b	A	A	B	C	N/A	N/A
7	100-41	A	B	B	C	N/A	N/A
8	100-45	B	N/A	B	C	N/A	N/A
9	100-81	A	A	B	C	N/A	N/A
10	100-294	B	N/A	B	C	N/A	N/A
11	100-323	A	C	B	C	N/A	N/A
12	101-292	A	B	B	A	A	A
13	101-66	B	N/A	B	A	B	A
14	101-67	A	C	B	A	B	A
15	101-123	A	B	A	C	N/A	N/A
16	125-32	A	A	B	A	B	A
17	125-33a	A	A	B	C	N/A	N/A
18	125-33b	A	A	A	A	B	A
19	125-38	A	C	B	C	N/A	N/A
20	125-65	A	A	B	C	N/A	N/A
21	125-98a	B	N/A	B	A	B	A
22	125-98b	B	N/A	B	A	B	A
23	125-99	A	A	B	C	N/A	N/A
24	125-140	A	A	B	A	B	A
25	125-142	B	N/A	B	A	B	A
26	125-143a	A	A	L	C	N/A	N/A
27	125-143b	B	N/A	B	C	N/A	N/A
28	125-165	A	A	B	C	N/A	N/A
29	102-6	B	N/A	B	A	B	A
30	102-78	B	N/A	B	B	0	A
31	102-79	A	A	B	A	A	A
32	104-14	A	B	A	C	N/A	N/A
33	104-69	B	N/A	B	A	B	A
34	102-181	A	B	A	A	A	0
35	103-16	B	N/A	B	A	B	A

[1] See Appendix IIC for details of decorated body sherd attributes.

[2] N/A = Attribute not applicable to this sherd.

[3] 0 = Attribute not measureable.

APPENDIX III
CERAMIC DATA

C2: DECORATED BODY SHERDS - AREA UPPER B

SHERD	CATALOGUE NUMBER	ATTRIBUTES[1]					
		1	2	3	4	5	6
1	112-3	A	A	A	A	A	A
2	118-39	A	B	A	A	A	A
3	118-73	B	N/A[2]	B	A	B	B
4	117-13	A	B	A	C	N/A	N/A
5	117-27	B	N/A	B	A	B	A
6	117-43	A	A	A	A	A	A
7	117-70	A	A	B	A	B	A
8	117-98	A	A	A	C	N/A	N/A
9	117-121	A	A	A	A	B	A
10	117-123	A	0[3]	B	A	B	A
11	117-137	A	A	B	A	B	A
12	118-119	A	A	A	C	N/A	N/A
13	122-31	A	A	B	C	N/A	N/A
14	124-9	A	A	B	C	N/A	N/A

[1] See Appendix IIC for details of decorated body sherd attributes.
[2] N/A = Attribute not applicable to this sherd.
[3] 0 = Attribute not measureable.

APPENDIX IV
LITHIC CODING FORMAT

INFORMATION	SPECIFICS	COLUMNS
Site designation	DlMa-1	1-5
Year collected	82; other collections can also be described by year designation	6-7
Area of site	01 = A; Park side, 3rd & upper bays 02 = Upper B; Park side, 2nd bay 03 = Lower B; Park side; lowest bay 04 = C; Park side; valley bottom & edge of Park 05 = D; both sides, oxbow below Park & under TransCanada Highway Bridge 06 = E; Park side; oxbow below MacPherson farm 07 = F; farm side; terrace at base of valley wall 08 = G; farm side; main terrace below Area F 09 = H; Park side; field above the Park 10 = I; farm side; field above valley wall on which mound is located	8-9
Excavation unit	Farm side (Area F) 99 = 0N 104E 100 = 0N 105E 101 = 0N 106E 102 = 1S 125E 103 = 0N 125E 104 = 2S 125E 125 = 8S 93E Park side (Area Upper B) 105 = 54N 24W 106 = 53N 24W 107 = 52N 24W 108 = 52N 25W 109 = 53N 25W 110 = 54N 25W 111 = 9S 40W 112 = 8S 40W 113 = 7S 40W 114 = 6S 40W 115 = 5S 40W 116 = 4S 40W 117 = 15S 47W 118 = 15S 46W 119 = 46S 25W	10-12

INFORMATION	SPECIFICS	COLUMNS
	120 = 46S 26W 121 = 46S 27W 122 = 47S 25W 123 = 47S 26W 124 = 47S 27W	
SE co-ordinates of unit	Farm side (Area F) ___ (N or S) ___ (E) in metres Park side (Area Upper B) ___ (N or S) ___ (W) in metres N or S co-ordinate columns 13-15 E or W co-ordinate columns 16-18	13-18
Level number	Unit specific; see excavation techniques; balk levels are prefixed by "9" to distinguish them from unit levels	19-20
Lowest DBS of level	Depth below surface in centimetres; unit specific; rounded to nearest cm	21-23
Catalogue number	Unit specific; continuous through all levels; main catalogue number may represent several artifacts	24-27
Secondary number	Used to separate flakes/artifacts pooled under the same catalogue number	28-29
Location north of SE datum	Location in cm north of SE corner datum; given to nearest cm for all diagnostics	30-32
Location west of SE datum	Location in cm west of SE corner datum; coded for diagnostics. In Feature 2, location is north and east of the datum	33-35
DBS of artifact	Depth below surface in cm; coded for diagnostics	36-38
Weight	Weight in grams to nearest 0.1 g; decimal not coded	39-43
Material class	01 = lithic 02 = pottery 03 = faunal 04 = botanical/other	44

INFORMATION	SPECIFICS	COLUMNS
Lithic artifact class	0 Debitage: 01 = nodular raw material 02 = core (more than 3 flakes removed) 03 = core fragment 04 = platform remnant bearing flakes 05 = bifacial thinning/resharpening flakes 06 = flake shatter 07 = block shatter 08 = linear blade-like flakes 1 Primary implements: 10 = rough uniface (few flakes removed) 11 = rough uniface fragment 12 = rough biface (few flakes removed) 13 = rough biface fragment 14 = utilized, unmodified flake 15 = utilized, unmodified blade/linear flake 2 Secondary implements: 20 = fine uniface (many flakes removed) 21 = fine uniface fragment 22 = fine biface (many flakes removed) 23 = fine biface fragment 24 = projectile point 25 = projectile point fragment	45-46
Raw material type	1 Quartz & quartzite other than Swan River Chert: 10 = translucent colourless 11 = coloured quartz 12 = coloured quartzite 13 = neutral/brown quartzite 2 Swan River chert: 20 = Swan River chert, all colours 3 Crypto-crystalline: 30 = obsidian 31 = jasper 32 = petrified wood 33 = chalcedony other than Knife River Flint 34 = Knife River Flint 35 = agate 36 = porcellanite	47-48

INFORMATION	SPECIFICS	COLUMNS
	4 Igneous & metamorphic igneous: 40 = granite 41 = rhyolite/rhyolitic 42 = schist 43 = basaltic	
	5 Chert other than Swan River chert: 50 = Selkirk chert 51 = cathead chert 52 = pebble chert 53 = undifferentiated chert 54 = beige calcareous chert 55 = Hudson Bay lowland chert	
	6 Sedimentary & metamorphic sedimentary 60 = greywacke 61 = silicified sediment	
	7 Unidentified material 70 = unidentified	
Size class or maximum length	Flakes: To nearest 0.1 cm using concentric circles in increments of 0.1 for nontool categories (Pokotylo in Pokotylo and Tisdale 1982); decimal not recorded; maximum dimension always recorded	49-52
	Tools: Maximum length of tools to .01 cm using calipers	
Cortex	0 = absent 1 = present 3 = cortex used as backing	53
Tool attributes: fine or rough	0 = indeterminate (too broken to tell) 1 = rough (few rough flakes) 2 = fine (many fine flakes)	54
Notching	Used only for projectile points 0 = indeterminate due to breakage 1 = unnotched/unstemmed 2 = side-notched 3 = corner-notched	55-56

INFORMATION	SPECIFICS	COLUMNS
	4 = basal-notched 5 = side/corner-notched 6 = base and corner or side-notched 7 = stemmed, symmetric 8 = stemmed with basal notch 9 = stemmed with side or corner notch 10 = stemmed, asymmetric	
Segment/Completeness of form	Projectile points: 0 = indeterminate 1 = complete 2 = base and notch 3 = medial body fragment 4 = fractured along longitudinal plane 5 = base and shoulder 6 = shoulder/body and tip 7 = notch and tip 8 = all but tip present 9 = basal or shoulder edges missing 10 = basal/shoulder edges and tip missing 11 = shoulder and body segment Bifaces: 0 = indeterminate 1 = complete 2 = end fragment 3 = medial body fragment 4 = fractured along longitudinal plane Unifaces: 0 = indeterminate 1 = complete 2 = end fragment 3 = medial body fragment 4 = fractured along longitudinal plane	57-58
Wear-Use/Other	1 = wear-use present; undifferentiated 2 = nibbling/use flaking 3 = polish 4 = water rounding 5 = heat treated 6 = nibbling/flaking and polish	59-60
Maximum tool width	Measured to .01 cm using calipers; no decimal coded	61-64

INFORMATION	SPECIFICS	COLUMNS
Maximum tool thickness	Measured to .01 cm using calipers; no decimal coded	65-68
Dorsal scars	Number of dorsal scars on platform remnant bearing flakes to determine reduction stage sequence	69-70
Bone bed	Coded for all units and balks: 0 = bone bed absent 1 = bone bed present	73
Density of bone bed	Coded for Units 99, 100, 101 and 125; codes represent relative density between the levels of an individual unit as based on bone counts and bone weights 1 = densest section of bone bed 2 = less dense section of bone bed 3 = least dense section of bone bed 4 = thin scattering of bone; not the bone bed 5 = negligible bone content; not the bone bed	74
Balk/Feature	2 = Feature 2 9 = balk	75
Co-ordinate designators	To indicate whether co-ordinates given for each unit are NW, NE, SW or SE	
	N/S designator corresponds to unit co-ordinate in columns 13-15 and indicates direction from base line used 1 = north 2 = south	76
	E/W designator corresponds to unit co-ordinate in columns 16-18 and indicates direction from base line used 1 = east 2 = west	77
Re-examine	1 = raw material identification 2 = artifact class identification 3 = raw material and artifact class identifications 11 = verify Tongue River sedimentary 12 = verify silicified sedimentary	78-79
Reference collection	1 = artifact pulled and used in raw material and artifact class reference collection	80

APPENDIX V
LITHIC DATA
A. ROUGH UNIFACES

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
1	101	13	1	2.7	20	2.64	0	1	1.51	0.66
2	101	40	0	2.3	32	2.85	1	1	1.47	0.57
3	101	174	1	112.8	20	6.98	1	1	4.40	3.30
4	101	214	1	8.9	20	4.10	1	1	2.54	1.23
5	99	45	1	8.7	33	0.00	1	2	2.93	1.23
6	99	85	2	2.2	20	2.60	0	1	1.46	0.50
7	99	93	0	5.1	34	3.30	0	1	1.55	0.74
8	99	96	0	1.3	36	2.86	0	4	0.00	0.20
9	99	243	0	2.7	31	2.83	3	1	1.34	0.58
10	99	247	0	0.9	34	0.00	1	2	1.92	0.33
11	99	284	0	3.6	36	2.80	0	1	2.11	0.66
12	99	357	2	1.2	32	2.60	1	4	0.00	0.38
13	100	16	0	6.2	20	3.97	0	4	0.00	0.80
14	100	120	1	1.7	31	2.90	0	1	1.53	0.40
15	100	125	0	45.3	20	6.38	1	1	3.85	1.96
16	100	190	0	8.0	51	4.91	0	1	1.77	1.20
17	100	227	1	1.3	35	0.00	0	0	0.00	0.79
18	100	395	3	1.6	20	2.22	0	0	1.64	0.37
19	100	395	4	0.7	20	1.52	0	1	1.10	0.34
20	100	467	2	2.7	20	2.90	0	1	1.75	0.83
21	101	282	1	27.9	20	5.64	1	1	3.50	1.40
22	101	294	1	10.7	33	3.44	3	1	2.38	0.92
23	101	300	1	1.8	20	0.00	1	2	2.03	0.48
24	102	21	0	19.4	20	5.10	0	1	3.37	1.18
25	102	109	0	4.8	36	2.64	0	1	2.16	0.80
26	102	167	0	0.9	53	2.00	0	1	1.42	0.25
27	102	168	0	5.5	10	2.12	0	1	1.82	1.86
28	107	24	0	3.6	33	2.16	1	0	1.58	0.83
29	114	19	0	3.1	52	2.25	3	1	1.41	0.80
30	118	41	0	2.4	31	2.46	1	1	1.70	0.67
31	118	88	0	1.0	34	2.30	0	1	1.54	0.22
32	119	12	0	4.1	33	2.32	1	1	2.25	0.92

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
33	119	53	0	3.2	34	3.53	1	1	1.46	0.62
34	125	146	0	4.9	32	3.63	0	1	1.40	0.90
35	125	149	0	1.0	31	0.00	3	0	0.0	0.26
36	125	169	0	1.5	34	2.20	0	1	1.61	0.43
37	125	243	0	6.4	34	2.88	3	1	2.67	0.80

APPENDIX V
LITHIC DATA
B. ROUGH BIFACES

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
1	101	68	1	3.7	51	0.00	0	2	3.05	1.02
2	101	68	2	1.5	20	0.00	0	2	2.95	0.67
3	101	216	0	1.0	34	0.00	1	2	1.94	0.30
4	101	217	0	0.9	51	1.84	1	1	1.30	0.35
5	101	219	0	2.2	20	2.07	0	1	2.21	0.38
6	99	85	21	0.6	35	0.00	0	0	0.00	0.00
7	99	156	0	1.5	61	0.00	0	2	2.54	0.35
8	99	239	0	6.6	20	0.00	0	2	3.33	0.65
9	99	285	0	65.9	20	7.42	1	1	5.80	1.40
10	100	84	7	2.6	20	0.00	0	0	2.10	0.66
11	100	84	9	0.9	33	0.00	0	3	0.00	0.50
12	100	187	1	0.5	33	0.00	0	0	0.00	0.62
13	100	228	2	1.5	20	0.00	0	0	0.00	0.55
14	100	300	0	0.3	34	0.00	0	2	1.47	0.20
15	100	470	0	1.4	31	1.84	1	1	1.46	0.39
16	101	282	2	1.5	20	0.00	1	1	3.50	1.40
17	102	46	0	0.8	20	0.00	0	0	0.00	0.40
18	104	48	0	5.8	20	4.00	3	1	2.40	0.47
19	113	48	0	4.1	53	0.00	1	2	3.22	0.53
20	119	4	0	3.5	53	4.00	0	1	2.00	0.53
21	125	72	0	0.4	20	0.00	0	0	0.00	0.24
22	125	244	0	0.8	20	1.90	0	1	1.16	0.38

APPENDIX V
LITHIC DATA
C. UTILIZED FLAKES

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
1	101	16	0	0.7	34	2.00	1	0	1.15	0.26
2	101	39	1	6.7	51	3.50	1	0	2.10	0.63
3	101	45	0	2.3	32	2.37	1	0	2.25	0.27
4	101	46	0	1.9	32	2.11	0	0	2.44	0.32
5	101	68	4	4.4	20	3.46	0	1	2.38	0.50
6	101	124	2	14.6	20	2.83	0	0	4.41	1.00
7	101	124	3	1.4	50	3.40	1	0	1.70	0.25
8	101	124	4	2.2	20	1.86	1	0	2.15	0.63
9	101	174	5	0.7	20	1.66	0	0	1.38	0.25
10	101	174	13	2.9	36	2.14	0	0	2.97	0.50
11	101	179	0	15.1	20	3.10	1	0	3.96	0.90
12	101	214	5	3.4	36	2.84	0	0	2.66	0.67
13	101	215	2	0.4	34	1.60	0	0	0.97	0.14
14	99	16	2	2.0	20	3.00	0	0	1.40	0.46
15	99	16	3	1.0	20	0.00	0	0	2.30	0.44
16	99	152	3	3.1	33	2.20	1	0	2.43	0.73
17	99	152	10	1.9	20	2.20	0	0	1.63	0.52
18	99	236	2	0.7	20	1.50	0	0	1.59	0.20
19	99	246	0	0.2	34	1.10	0	0	1.13	0.14
20	99	282	3	2.7	20	2.50	0	0	2.86	0.41
21	99	307	1	2.3	20	2.64	1	0	1.53	0.45
22	99	317	9	1.5	51	2.30	1	0	2.45	0.36
23	100	17	0	8.0	20	3.78	0	0	2.40	0.85
24	100	86	0	3.7	20	2.28	0	0	2.65	0.60
25	100	1270	0	6.1	31	3.00	1	0	2.14	1.04
26	100	1280	0	21.1	40	4.60	1	0	3.61	1.38
27	100	191	0	2.6	20	2.15	0	0	1.88	0.58
28	100	231	0	0.7	34	1.20	1	0	1.73	0.33
29	100	299	0	3.3	20	1.50	0	0	3.06	0.58
30	100	325	1	2.9	20	1.78	0	0	3.04	0.42
31	100	365	0	2.9	35	1.83	3	0	1.70	0.86
32	100	395	6	1.7	36	2.83	0	0	1.26	0.64

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
33	100	395	7	2.8	20	1.96	0	0	1.87	0.53
34	100	395	8	0.9	35	1.10	3	0	1.74	0.45
35	100	467	3	3.7	20	2.72	0	0	2.72	0.48
36	100	467	4	0.4	33	1.10	0	0	1.51	0.23
37	100	498	0	1.6	33	2.20	0	0	1.55	0.50
38	101	282	3	7.1	20	2.92	0	0	2.10	1.36
39	101	282	4	1.2	20	2.74	0	0	1.06	0.55
40	102	45	0	13.7	20	3.12	1	0	4.10	1.15
41	102	76	0	2.5	50	2.34	0	0	2.10	0.43
42	104	24	0	0.7	20	1.34	0	0	2.00	0.24
43	107	16	0	0.9	20	1.50	0	0	1.60	0.26
44	110	13	0	7.2	20	2.39	1	0	2.30	1.10
45	111	8	0	3.7	36	3.50	0	0	2.33	0.41
46	111	21	0	0.4	34	1.66	0	0	1.30	0.15
47	118	22	1	3.3	20	1.96	3	0	1.55	0.88
48	118	84	1	0.9	34	1.93	0	0	1.54	0.32
49	122	69	1	1.0	33	1.70	0	0	1.90	0.38
50	125	37	0	7.8	20	3.33	0	0	2.68	0.86
51	125	38	0	4.3	20	3.10	0	0	1.91	0.70
52	125	39	0	3.0	20	3.27	1	0	2.47	0.43
53	125	48	2	1.2	36	2.58	0	0	1.27	0.40
54	125	69	0	0.8	20	1.55	0	0	1.83	0.40
55	125	145	0	2.9	20	3.00	0	0	1.90	0.57
56	125	168	0	7.6	20	3.60	0	0	3.28	0.62

APPENDIX V
LITHIC DATA
D. FINE UNIFACES

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
1	101	39	2	2.0	20	2.43	0	1	1.31	0.69
2	101	68	3	0.1	51	0.00	0	0	1.20	0.30
3	101	218	0	3.0	35	2.03	0	1	1.62	0.77
4	101	249	0	0.6	36	1.41	0	4	0.00	0.34
5	99	86	0	1.9	36	3.15	0	1	0.00	0.33
6	99	89	0	0.6	34	0.00	0	3	1.54	0.24
7	99	154	0	1.1	33	2.46	0	1	1.20	0.25
8	99	157	0	1.2	36	2.13	3	1	1.16	0.26
9	99	158	0	0.4	34	0.00	0	3	1.50	0.16
10	99	238	0	6.0	35	3.21	3	1	3.15	0.66
11	99	251	0	1.8	34	2.36	0	1	1.37	0.61
12	100	56	0	1.4	34	2.35	0	1	1.72	0.30
13	100	302	0	5.9	31	3.60	3	1	1.90	0.82
14	100	327	0	4.4	36	2.28	0	1	2.10	0.60
15	100	396	0	2.3	35	1.85	3	1	1.44	0.64
16	100	397	0	2.6	34	2.92	0	1	1.33	0.50
17	113	49	0	4.7	34	2.70	1	1	2.00	0.89
18	121	28	0	0.4	34	0.00	1	2	1.66	0.17
19	125	211	0	0.3	34	0.00	0	2	0.00	0.24

APPENDIX V
LITHIC DATA
E. FINE BIFACES

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick
1	101	182	0	5.8	35	3.80	0	1	1.74	0.58
2	99	283	0	0.6	33	0.00	0	3	1.08	0.32
3	100	15	0	1.4	20	0.00	0	2	2.42	0.85
4	100	395	5	5.4	32	3.53	1	2	1.90	0.60
5	100	398	1	0.3	34	0.00	0	2	0.00	0.20
6	112	41	0	2.9	36	2.46	0	1	1.33	0.62
7	121	41	0	0.5	51	0.00	0	0	0.00	0.24
8	125	171	0	43.9	40	0.00	0	2	5.05	1.10

APPENDIX V
LITHIC DATA
F. PROJECTILE POINTS

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick	Notching
1	101	15	0	0.8	34	1.52	0	1	1.46	0.34	2
2	101	41	0	2.0	20	0.90	0	6	1.00	0.20	0
3	101	78	0	0.8	53	2.13	1	6	0.00	0.30	0
4	101	125	0	3.0	34	0.00	0	10	2.0	0.64	2
5	101	180	0	1.5	20	2.10	0	8	1.57	0.52	1
6	101	181	0	0.4	34	0.00	0	6	1.00	0.26	0
7	101	232	7	0.5	33	0.00	0	9	0.00	0.35	0
8	101	234	0	0.4	36	0.00	0	3	1.30	0.36	0
9	101	235	0	0.5	36	0.00	0	3	1.45	0.32	0
10	101	237	0	0.8	20	0.00	0	8	1.34	0.31	2
11	99	18	0	0.8	34	0.00	0	10	0.00	0.55	2
12	99	21	0	0.3	20	1.0	0	2	1.62	0.24	0
13	99	48	0	0.8	20	2.10	0	1	1.34	0.23	2
14	99	51	0	0.6	51	0.00	0	6	1.18	0.30	0
15	99	45	2	0.2	36	1.60	0	4	0.00	0.30	0
16	99	85	9	0.7	34	1.83	1	4	0.00	0.25	0
17	99	91	0	1.9	51	2.14	0	8	1.65	0.44	2
18	99	153	0	0.9	36	1.90	0	1	1.25	0.40	5
19	99	155	0	1.0	33	0.00	0	10	1.54	0.26	2
20	99	161	0	0.4	34	1.50	1	1	0.96	0.27	1
21	99	165	0	0.5	51	0.00	0	6	1.17	0.25	0
22	99	244	0	1.2	20	0.00	0	6	1.62	0.44	5
23	99	248	0	0.8	34	1.76	0	1	1.53	0.23	2
24	99	357	1	0.5	36	0.00	0	3	1.53	0.32	0
25	99	340	0	0.4	70	1.74	1	1	1.00	0.25	2
26	100	57	0	1.4	20	1.86	0	8	1.55	0.40	0
27	100	88	0	0.4	35	0.00	0	10	1.15	0.19	2
28	100	126	0	0.7	36	1.76	0	1	1.30	0.30	2
29	100	189	0	0.5	34	1.60	0	1	1.27	0.27	2

Case-N	Unit	CatNo	SecNo	Weight	Raw Mat	Length	Cortex	Segment	Width	Thick	Notching
30	100	232	0	0.9	10	1.87	0	6	1.45	0.35	0
31	100	304	0	1.1	20	2.18	0	1	1.52	0.31	2
32	100	305	0	0.8	55	1.85	0	7	1.40	0.30	0
33	100	306	0	0.3	20	0.00	0	6	1.00	0.27	0
34	100	307	0	0.8	53	0.00	0	6	1.30	0.38	0
35	100	308	0	0.4	20	0.00	0	5	1.76	0.27	2
36	100	309	0	0.5	34	0.00	0	5	1.47	0.27	6
37	100	328	0	0.5	51	0.00	1	5	1.40	0.36	2
38	100	343	0	0.9	41	1.83	1	1	1.25	0.47	2
39	100	377	0	0.4	33	0.00	0	6	1.11	0.40	0
40	101	295	0	0.9	34	2.13	0	9	1.08	0.40	2
41	101	301	0	0.7	20	0.00	0	3	1.46	0.33	0
42	103	10	0	0.5	20	0.00	0	8	1.35	0.20	2
43	102	125	0	0.3	20	0.00	0	6	1.02	0.25	0
44	102	134	0	1.0	51	0.00	1	10	1.38	0.30	2
45	111	37	0	1.1	34	2.28	0	7	1.64	0.23	2
46	116	5	0	0.8	53	2.00	1	6	1.27	0.29	0
47	117	107	0	0.8	34	0.00	0	5	1.55	0.36	2
48	117	108	0	1.8	34	2.10	0	3	1.50	0.48	0
49	118	58	0	0.3	34	0.00	1	2	1.70	0.25	2
50	125	36	0	0.4	33	0.00	0	6	1.40	0.30	0

APPENDIX VI

SEDIMENTOLOGICAL METHODOLOGY

> Many practical procedures purport to yield a measure of the size of particles of disaggregated materials; each technique has certain specific advantages and usually a set of limiting conditions within which the technique operates satisfactorily. Unfortunately, since few natural materials meet the conditions required by these techniques, all procedures in practise are, in varying degree, compromises between theoretical demands and practical difficulties in meeting these demands (Griffiths 1967:54).

Despite these inherent difficulties, reliable grain size analyses of sediments may be done using a number of laboratory methods. Coarser sediments or the coarser portion of a sediment are commonly separated using sieving techniques. Very fine sands to small pebbles are usually separated in sieves where similar sieving times and similar weights are used. For finer sediments, clay to coarse silt grades, sedimentation methods are employed to ascertain the settling velocity of grains through a column of water. When the grain size distribution has been determined, the sediment can then be characterized by a number of features: mean grain size, mode, median grain size, sorting and skewness. The graphic presentation of grain size distribution will yield these parameters. Alternately, they may also be determined directly from the size data (Tucker, 1981). Many sources provide detailed descriptions of methods for the measurements of grain size, treatment of data and the interpretation of grain size characteristics. Included among them are Tucker, 1981; Friedman and Sanders, 1978; Fuchtbauer, 1974; Carver, 1971 and Muller, 1967.

A wet sieving technique was used on Stott Site materials for the retention of coarse grain sediments. This method was chosen because wet sieving "when applied to particle size analyses is normally used for removal of fine dust which if allowed to pass into a long series of sieves is likely to impair their efficiency" (Allman and Lawrence, 1972:174). Given also the tendency for the fine grain sediments to resist mechanical disaggregation, wet sieving is assumed to provide a more reliable picture of grain size distribution than simple dry sieving. The procedure is given as follows:

1. Divide sample according to amounts needed for tests and reference material. A separator may be used to insure that pre-test sorting does not occur. The sample is commonly quartered to insure that sufficient material is retained for reference and other tests or can be used to run again as a check on initial results.
2. Weigh the quarter sample or use a standard 100 g sample. So long as the sample is of sufficient size, ie. 75 g or more, a standard amount is not necessary since the fractions subsequently determined for it are percentages of the total. A sample quantity of 100 g is, however, convenient for statistical use.
3. Place sample in a 1000 ml beaker and add 50-75 ml of 10% Calgon (sodium hexametaphosphate) solution (one part Calgon to ten parts distilled water). Stir to mix.
4. Record empty weight of 230 (4 Ø) mesh screen.
5. Place the sieve in the sink and wash sample thoroughly into 230 mesh screen. Wash sample till water runs clear, that is, until the silt and clay fraction has been removed.
6. Place in oven (about 60° C) until dry. Remove from oven and weigh when cooled.
7. Take empty weights of coarse grain sediment screens. Here mesh sizes 170, 120, 80, 60, 45, 35, 25, 18, 14 and 10 were used.

8. Gently scrape sample from 230 mesh screen into assembled screens. The screens are placed in descending order from coarse to fine.

9. Place assembled screens in sieving machine for 15 minutes.

10. After sieving is finished, take full weights of each screen.

11. Express data as:

Sieve #	Wt. of sieve empty	Wt. of sieve full	Fraction weight	% from total	Sample weight	Provenience
Pan						

12. Percentages are graphed together with the fine fractions in histograms, cumulative frequency curves or other graphic representations. Histograms indicate the quantity of grains in each size class and provide an immediate impression of grain size distribution. Cumulative frequency curves indicate the percentage frequency of grains coarser than a particular value and give percentiles of the distribution -- in other words, the grain sizes which relate to specific percentage frequencies.

Grain size analysis of fine sediments was done by pipette sedimentation. Pipette sedimentation is one method which attempts to measure the grain size of a sediment by settling in water. After removing the organic material and then de-flocculating, silt and clay fractions are determined by extracting sub-samples at given time and depth intervals from a settling column of water and clay-silt sample. The procedure is given as follows:

1. Estimate percentage of silt and clay in a given test sample.

2. Weigh enough disaggregated, oven dried sample so that about 10 g are silt and clay from the total. A minimum of 1 g of silt and clay is necessary for accurate grain size analysis of the fine fraction. If the amount of fine sediments exceeds 25 g, then hindered settling will occur and the results will be unreliable.

3. Organic matter inhibits dispersion and it is common practice to remove organics by oxidation with hydrogen peroxide. Place the sample in a tall beaker, adding 50 ml of hydrogen peroxide, and heat gently on a bunsen burner. A few drops of amyl alcohol may be added to quiet the reaction if excessive frothing takes place. Alternately, the solution may be allowed to stand for several hours until frothing ends and then boiled to remove residual peroxide.

4. Add 50 ml of 10% Calgon solution, a dispersant, and then wash everything into one of the highform buffer cups of a high speed stirrer. Use distilled water for the transfer. Insure that all the sample goes into the highform cup and stir for 20 minutes.

5. While the solution is being stirred, weigh a 50 ml beaker to ± 0.001 g. Add 50 ml of the Calgon solution and dry in the oven. When all of the water in the solution has evaporated and only the Calgon remains, allow to cool and weigh the residue.

6. Transfer all the sample from the highform cup to a 1000 ml measuring cylinder and fill to exactly 100 ml with distilled water.

Pipette Withdrawals

1. Assemble 5 50 ml beakers and weigh to ± 0.001 g.

2. Stir the sample in the cylinder for at least two minutes using a vertical stroking motion. Stir right up to the surface of the liquid,

making certain that the sediment is completely dispersed. Stop stirring at a known time.

4. Transfer the liquid to a pre-weighed 50 ml beaker. Hold the pipette vertically and gently blow out the residual liquid and sediment. Lightly dip the pipette into the liquid in the beaker to complete the transfer.
5. Repeat this procedure at 10 cm depths at times of 1 m. 56 sec., 7 m. 44 sec., 31 m., and at 2 hr. 3 m. Table 61 gives a scheme by which six samples can be analysed at one time.
6. Dry the samples in the beakers at 110°C. Let the samples cool and then weigh them.
7. Data are calculated by subtracting the weight of the empty beaker from the weight of the beaker and sample. A certain amount of Calgon dispersant remains in each 20 ml pipette extraction. The weight of the dispersing agent is subtracted from the sample weight. See Figure 97 for sample data sheet. Present data as in Table 61.

The difficulties involved in using sedimentological methods for determining reworking on till surfaces is well known. Tucker (1981) indicates that debris flow surfaces, of particular importance here, may be difficult to distinguish from sediments deposited directly from a glacier. At DlMa-1, however, a lacustrine blanket of predominantly fine sands caps the Assiniboine valley wall and adjoins the clay-silt comprised till scarp and terrace. According to the model given in Chapter II, it is possible that the distribution of these fine lacustrine sands over the neighbouring till landscape may provide a useful index as to where and to what depth reworking

TABLE 61

PLAN FOR MULTIPLE PIPETTE ANALYSES
20°C   6 SAMPLES

	1	2	3	4	5	6
0	stir					
2	out					
2 20	4 Ø (PHi)					
3 56	5 Ø					
4		stir				
6		out				
6 20		4 Ø				
7 56		5 Ø				
9 44	6 Ø					
10			stir			
12			out			
12 20			4 Ø			
13 44		6 Ø				
13 56			5 Ø			
14				stir		
16				out		
16 20				4 Ø		
17 56				5 Ø		
19 44			6 Ø			
20					stir	
22					out	
22 20					4 Ø	
23 44				6 Ø		
23 56					5 Ø	
24						stir
26						out
26 20						4 Ø
27 56						5 Ø
29 44					6 Ø	
33 00	7 Ø					
33 44						6 Ø
37 00		7 Ø				
43 00			7 Ø			
47 00				7 Ø		
53 00					7 Ø	
57 00						7 Ø
2 05 00	8 Ø	(2 09)	(2 15)	(2 19)	(2 25)	(2 29)

All withdrawals at 10 cm, except 4 Ø at 20 cm. (Adapted from Nielsen, n.d.)

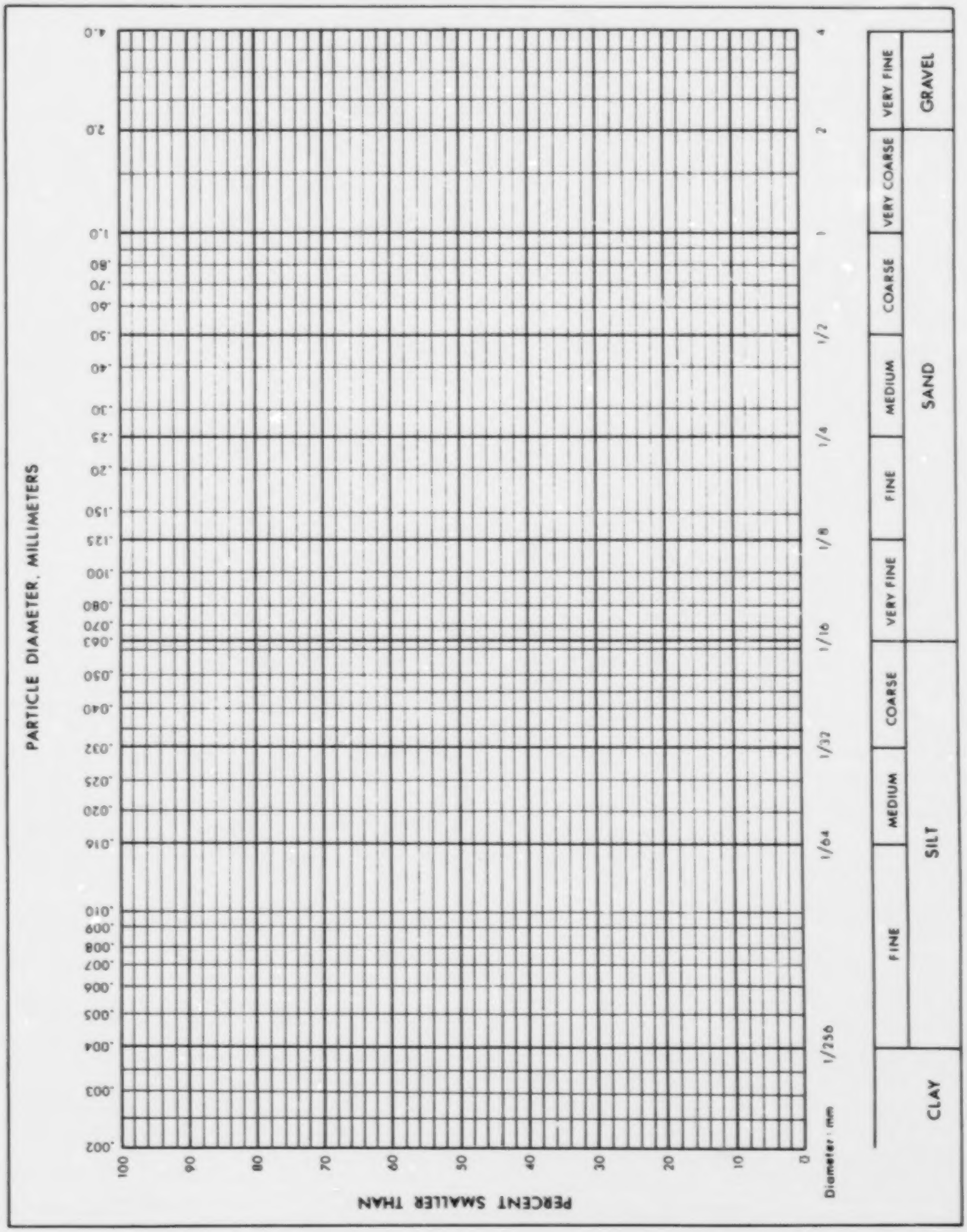


Figure 97. Sample data sheet.

processes have occurred on the excavated terrace and terrace scarp. As such, the presence of lacustrine-derived sands in a given depositional unit should provide a useful prima facie suggestion as to whether the deposit has been reworked in the past or has not been greatly affected by erosional processes.

The following histograms give some examples of grain size data for samples taken from the lacustrine plain, the convex creep slope and terrace scarp.

Figure 98 provides a graphic representation of grain size data for one lacustrine sample. The sample is mostly composed of very fine sands (phi sizes 3.0 - 4.0). Although the ratio of coarse to fine fractions varies within the lacustrine sediments at the valley top, the lacustrine materials are typically composed of these very fine sands and are commonly well-sorted in the 03.0 - 04.0 range.

Figure 99 gives the grain size distribution for unmodified till. Strat Unit 5 is located on the creep slope portion of the terrace scarp and comprises a zone of active erosion. The sample was taken at a depth below the surface enrichment of the till by sands from the bordering lacustrine plain. These sands were contributed to the till surface by runoff, creep and other secondary reworking processes. The histogram shows the erosionally unmodified composition of the till scarp and is assumed to be representative of the till which comprises the terrace and terrace scarp. The till is clay-silt based, with only a small proportion of coarse materials. Unlike the lacustrine sediments which are mostly composed of very fine sands, the unmodified till contains less than 4% of very fine sands.

Figures 100, 101 and 102 show the grain size distribution of lacustrine enriched till in Strat Unit 6. This unit is located at an

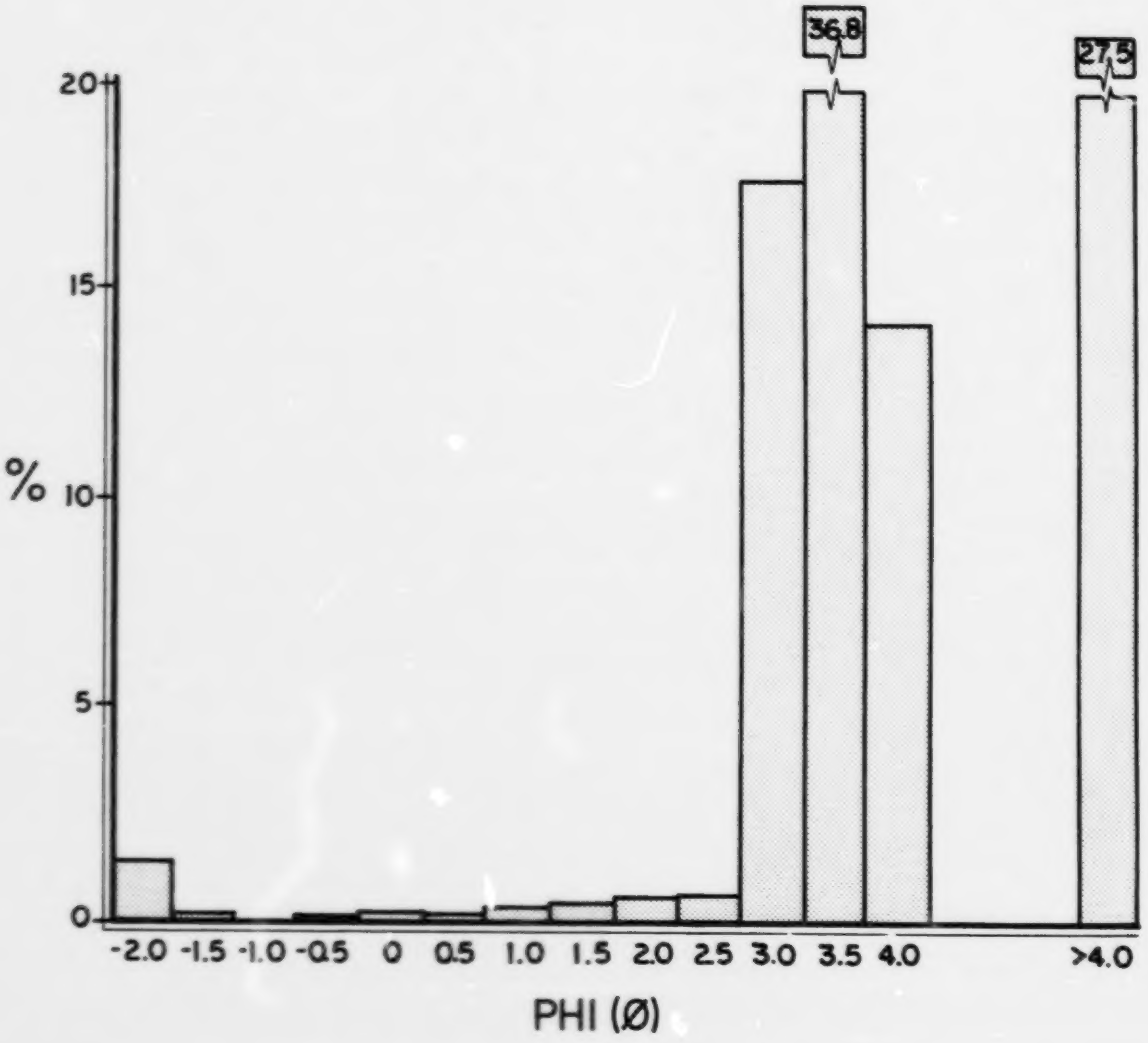


Figure 98. Grain size distribution of lacustrine sediments.

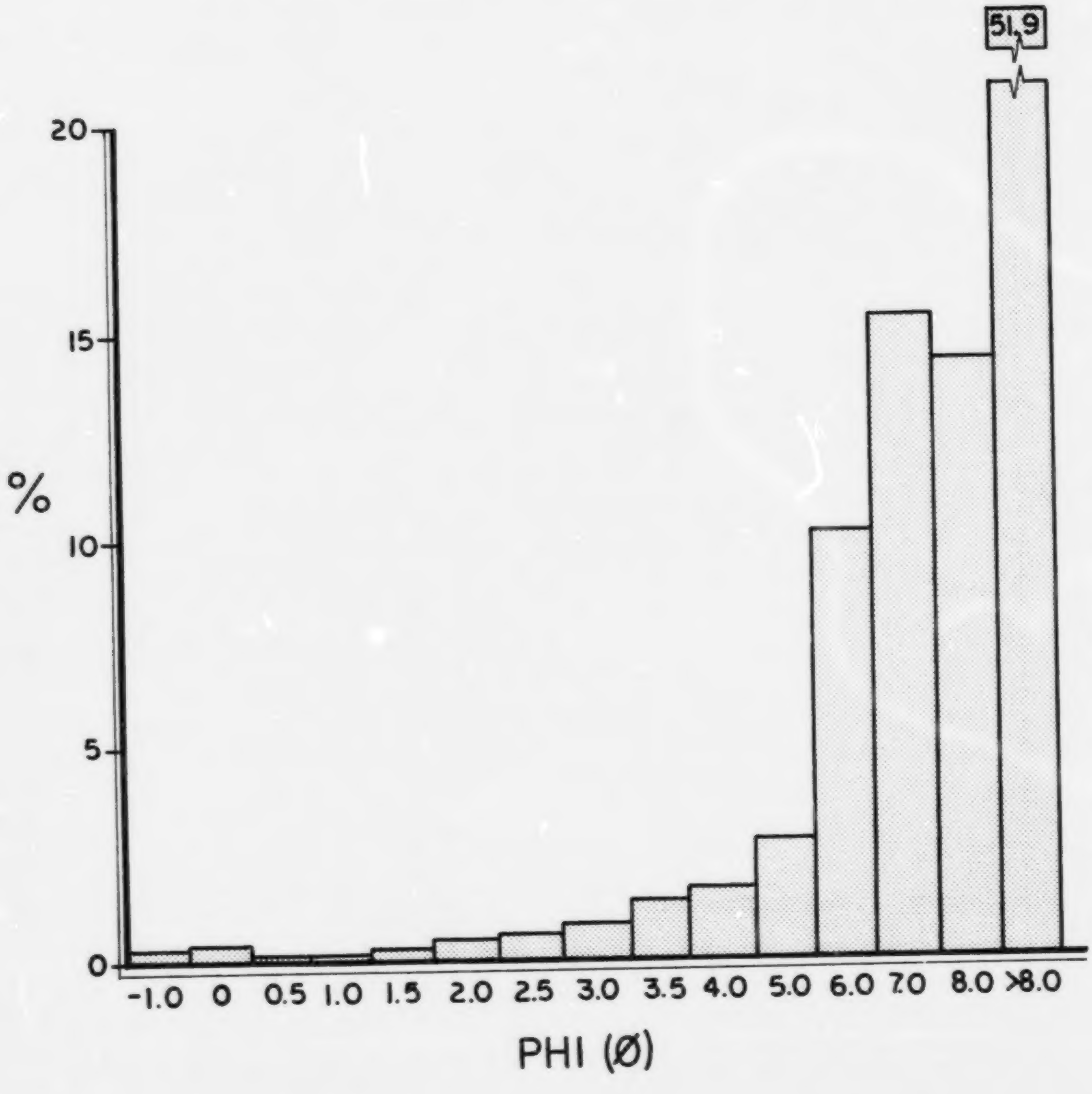


Figure 99. Grain size distribution of unmodified till.

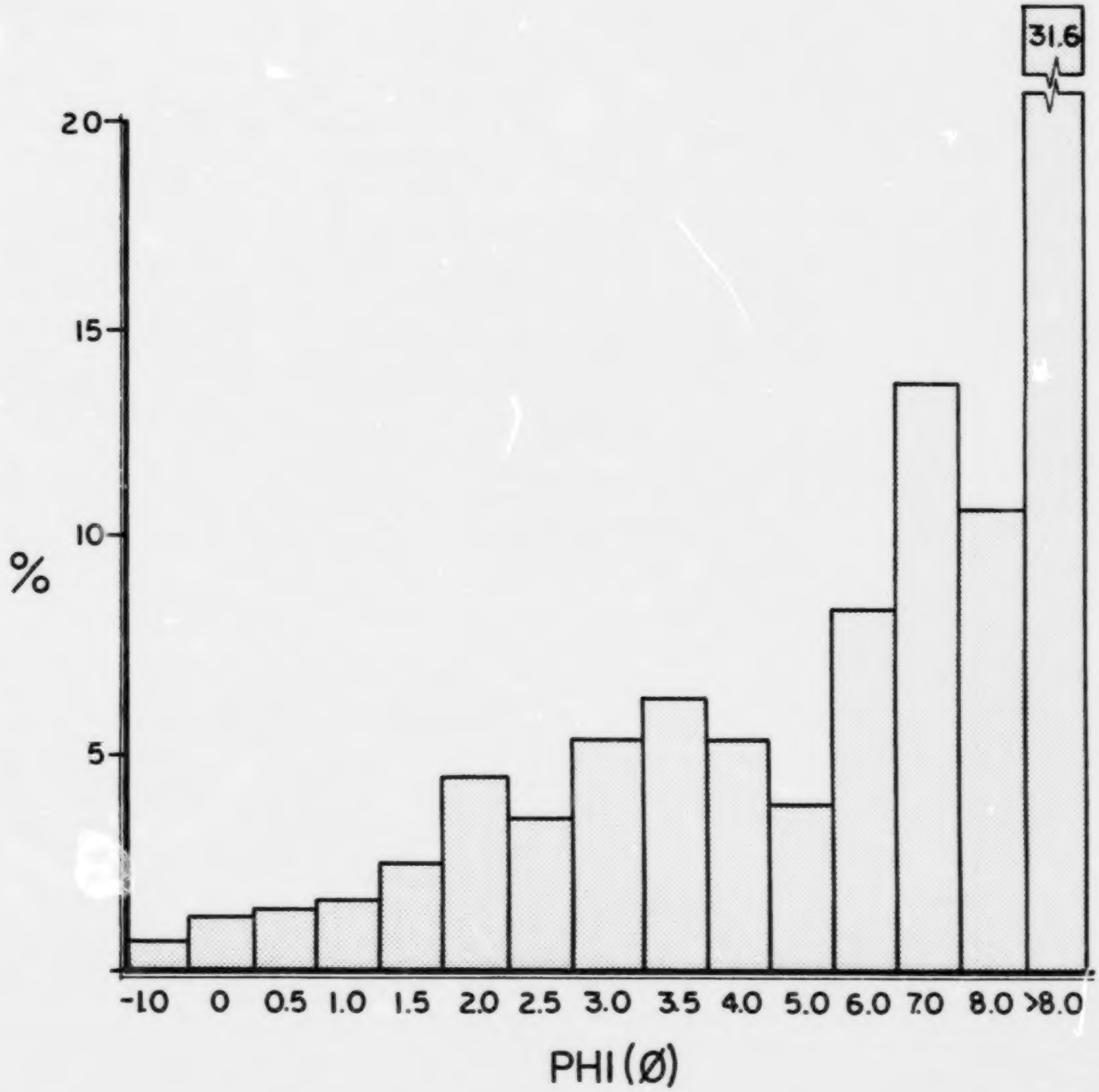


Figure 100. Grain size distribution of lacustrine enriched till: Strat Unit 6, 2 - 12 cm DBS.

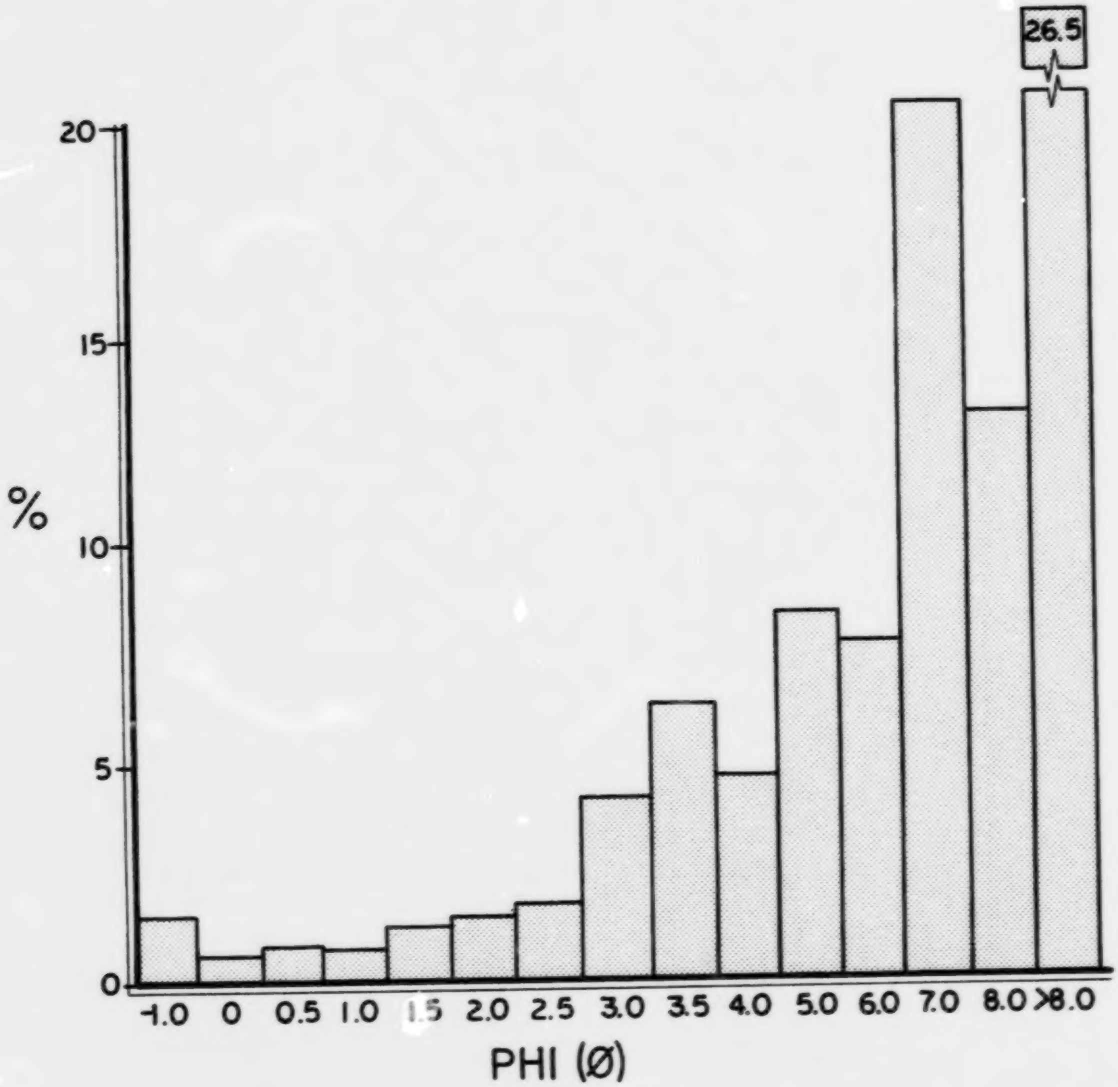


Figure 101. Grain size distribution of lacustrine enriched till: Strat Unit 6, 24 - 35 cm DBS.

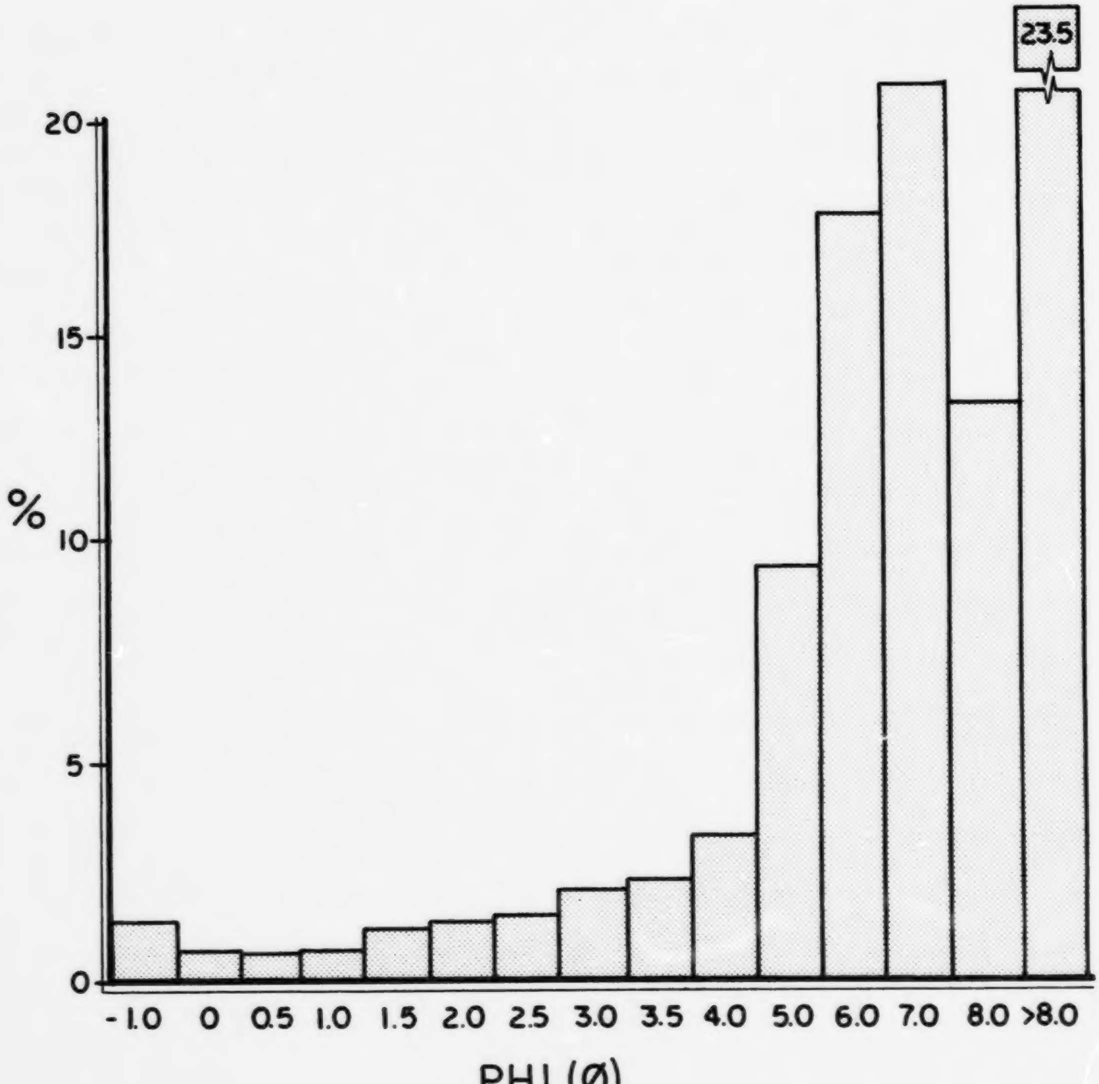


Figure 102. Grain size distribution of lacustrine enriched till: Strat Unit 6, 47 - 60 cm DBS.

elevation 4 m lower than Strat Unit 5 and represents a zone of deposition for colluvial materials. Samples were taken from near the surface to near the bottom of the unit.

Figure 100 shows a comparatively high proportion of very fine sands in the till sample. Since the scarp is composed of till and the till is assumed to be similar to that of the erosionally unmodified till occurring in Strat Unit 5, then the presence of very fine sands here must be a result of the erosion and transportation of lacustrine materials from the valley top.

Figure 101 gives grain size data for a sample taken from greater depth in the unit and shows a decline in the proportion of lacustrine-derived materials with a corresponding increase in the till-derived silt portion.

In Figure 102, the lacustrine-derived very fine sands have declined to levels approaching the fine sands normally occurring in unmodified till. Such findings suggest that in this slope position and at this depth the effect of the erosional processes is declining. Given the declining amount of these lacustrine sands, it is probable that erosional factors have not greatly affected the till scarp much below the excavated depth of the unit, here 85 cm, and the limit of colluvial material has been reached.

Although the use of lacustrine-derived sands may provide an indicator as to where and to what depth the erosion, transport and deposition of land surface materials have occurred, it does not show by what means these processes have taken place. Cumulative frequency curves indicate the sorting which has occurred in a given deposit. Sorting in turn, a very useful indicator of the mode of transportation and deposition of a sediment, is a function of various characteristics of the transporting agent and the depositional environment. Wind, for example, is normally a very efficient sorting agent because it is not capable of transporting large particles, such as coarse sands, or very small particles such as clays. Wind has a very small density and viscosity; hence the size of particles which can be transported depends upon wind velocity and its fluctuations. Materials suspended by the wind are dropped out as fluctuations in velocity occur, with heavier particles falling out as velocity decreases. Glacier ice, on the other hand, is extremely viscous and can carry a heterogeneous mix of materials varying in size from huge boulders to fine clays. These are non-sorted deposits.

Sorting can be evaluated visually from cumulative frequency curves by the slope of the curve. Sediments which are well sorted have a steeply sloping curve, at least in the central part, although the tails of the slope may be more gentle. Poorly sorted sediments are much more gradually sloping, rising from lower left to upper right.

Figure 103 gives cumulative frequency curves showing sorting in (a) lacustrine and (b) unmodified till.

The lacustrine sample is moderately well sorted in the very fine sand fraction and the major portion of the sample is comprised of sands.

The unmodified till is less well sorted and the sample is mainly composed of clay and silt. In the ground, the profile from which the sample was taken shows a heterogeneous mix of pockets of clays and silts, with a scattering of pebbles and stones characteristic of till. As well, the ground surface is marked by the occasional large boulder. The slope of the curve, however, is similar to that for lake bottom sediments (Fookes et al., 1975:43, 44; Figure 103[c]). This suggests that either the source material for the till is comprised of sediments of lake bottom origin or that the sample represents a lobe of slumped lake bottom material and is not till, but rather

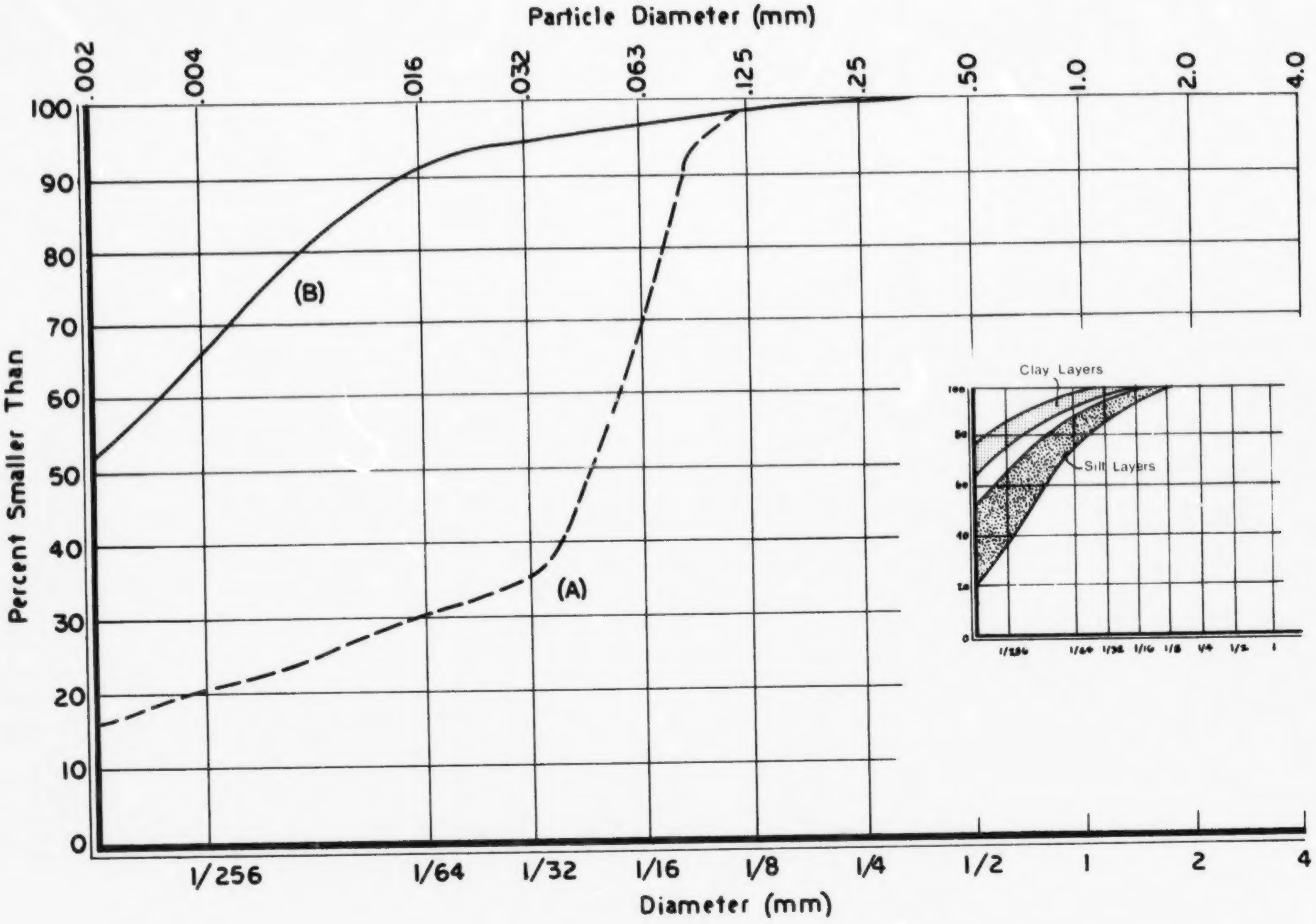


Figure 103. Cumulative frequency curves of grain size distribution of lacustrine sediments and unmodified till in Strat Unit 4.

an underlying layer of lake bottom deposits not encountered in the upper elevation lacustrine plain. In the latter case, the apparently heterogenous nature of the deposit would be accounted for by deformation through erosional events. Neither interpretation, however, is conclusive because there is only one area of the site in which unmodified samples of either unmodified till or unmodified lake bottom sediments have been collected and tested (Strat Unit 5). The deposit occurring at the bottom of Strat Unit 6 is not highly modified, but still shows some enrichment by lacustrine sands from the valley top.

If the sample from Strat Unit 5 is of lake bottom origin and not till, then:

1. The clay-silt deposit occurring in the bottom of Strat Unit 6 is also probably not till, but is of lacustrine origin as well. The upper portion of the scarp is composed of lake bottom deposits and is not till. Further, the churned, viscous flow surface overlying the clay-silt deposit in the bottom of Strat Unit 6 would, therefore, be fine lake bottom materials enriched with lacustrine fine sands from the valley top and not lacustrine-enriched till.
2. If the fine lake bottom material does not extend much below Strat Unit 6 and the lower portion of the scarp is indeed comprised of clay loam - loam till, as indicated in the Canada-Manitoba Soil Survey of 1976, then use of lacustrine sand enrichment to indicate reworking on the scarp and terrace would be limited. The model can operate only if the lacustrine sands are moving over or are incorporated within uniformly fine textured sediments. If the lacustrine sands are incorporated into a loamy till, the lacustrine-derived sands could

not be distinguished from those sands already present in the unmodified clay loam - loam till itself. Under these conditions the model would fail. The model could, however, still be useful on upper portions of the scarp, where the lacustrine-derived sands would be deposited on or worked into the fine-textured lake bottom sediments which comprise the upper aspect of the slope. It could still be valid from Strat Unit 5 to an elevation below Strat Unit 6 and possibly as far as Strat Unit 7. The model would, therefore, be restricted, but still useful within its reduced limits.

Figures 104, 105 and 106 give cumulative frequency curves showing the sorting that occurred in three samples taken at increasing depths in Strat Unit 6. The curves demonstrate that all samples are poorly sorted and that the amount of lacustrine-derived sands contained in the deposit decreases with depth. In the deepest sample, little lacustrine sands are present and the curve begins to take on the slope of the unmodified till (or the unmodified lake bottom sediment) of Strat Unit 5 (see Figure 103[b] and explanation). As in Figure 102, the effect of the reworking processes is shown to be declining and the limit of colluvial material is nearly reached. It is likely that not much below the depth of this unit, the scarp has not been affected by the erosion and transport of slope materials. At that point, the underlying material should be similar to that of Strat Unit 5.

The poorly sorted nature of the deposit suggests a poorly sorting depositional mechanism such as various types of viscous land-flows. Solifluction, a type of wet or semi-frozen landflow, and wet flows such as earth or mudflows are examples of poorly sorting or nonsorting depositional

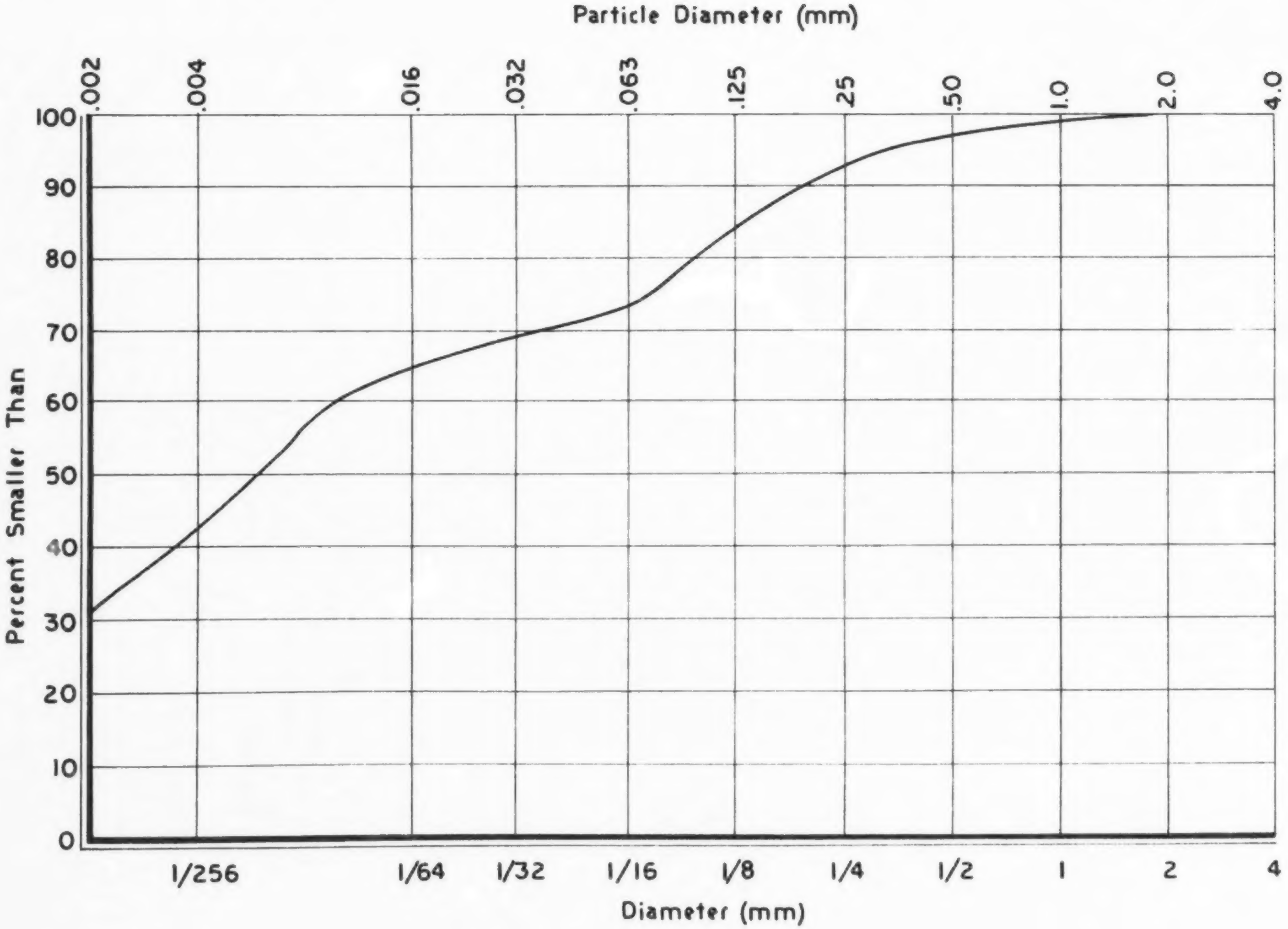


Figure 104. Cumulative frequency curve of grain size distribution of lacustrine enriched till: Strat Unit 6, 6 - 12 cm DBS.

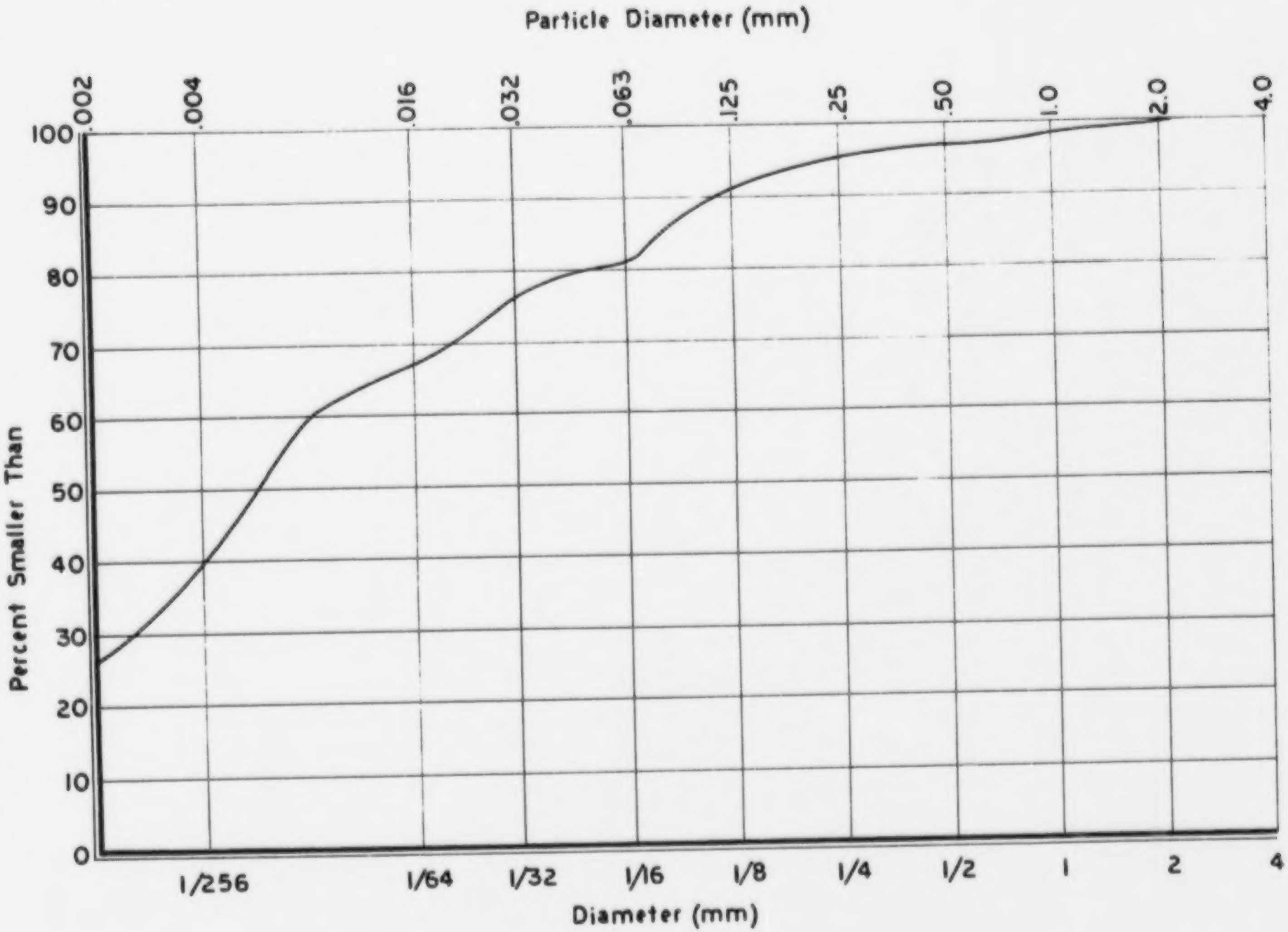


Figure 105. Cumulative frequency curve of grain size distribution of lacustrine enriched till: Strat Unit 6, 24 - 35 cm DBS.

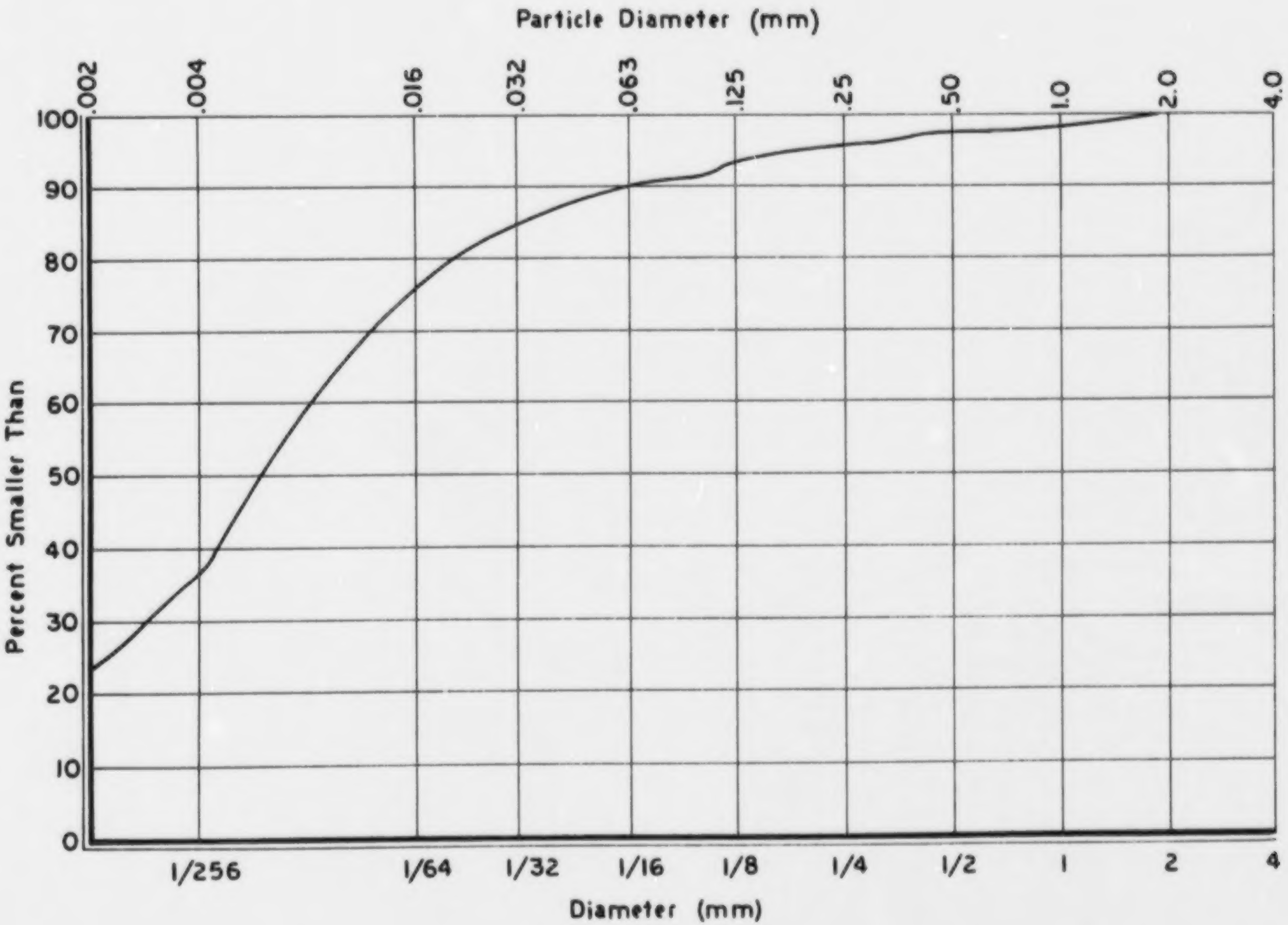


Figure 106. Cumulative frequency curve of grain size distribution of lacustrine enriched till: Strat Unit 6, 40 - 67 cm DBS

mediums (Hutchinson, 1968; Crandell, 1968; Sharpe, 1960). Solifluction phenomena are rather shallow slope movements which involve the slow, downslope transport of surface materials under the influence of freeze-thaw processes. They are characterized as "lobate or terrace-like surface forms developed in the upper metre or so of the soil" (Williams, 1982:173) and are more active when shallow thawing of the slope results in saturation of the surface layer above the impermeable, still frozen subsoil (Hutchinson 1968). Solifluction can take place on slopes as low as 2-3°, but slopes of 5-20° are optimum (Price, 1972). Mudflows are flowing masses of "predominatly fine-grained earth material that possess a high degree of fluidity during movement" and are "intermediate members of a gradational series of processes characterized by different proportions of water and rock debris" (Crandell, 1968:763). With a decrease in water they grade into earthflows. Conversely, earthflows are composed of fine-textured material, but become mudflows at a very high water content.

In pedological terms, the upper sample was taken from the Ah horizon of the soil profile, the middle sample was taken from the Ah/Ck mix and the bottom sample was taken from the Ck horizon. Grain size data indicate that the developing Ah is forming in the currently stable surface of the viscous flow, whereas the Ah/Ck mix reflects the churned appearance of the transported lacustrine sands, fine-grained till (or lake bottom sediments) and organic materials as they moved downslope. The Ck horizon has only been moderately affected by the flow.

Figure 107 gives a cumulative frequency curve showing sorting in lacustrine-enriched till in Strat Unit 7. This unit is located approximately 4 metres lower in elevation than Strat Unit 6; the sample was taken from 22-33

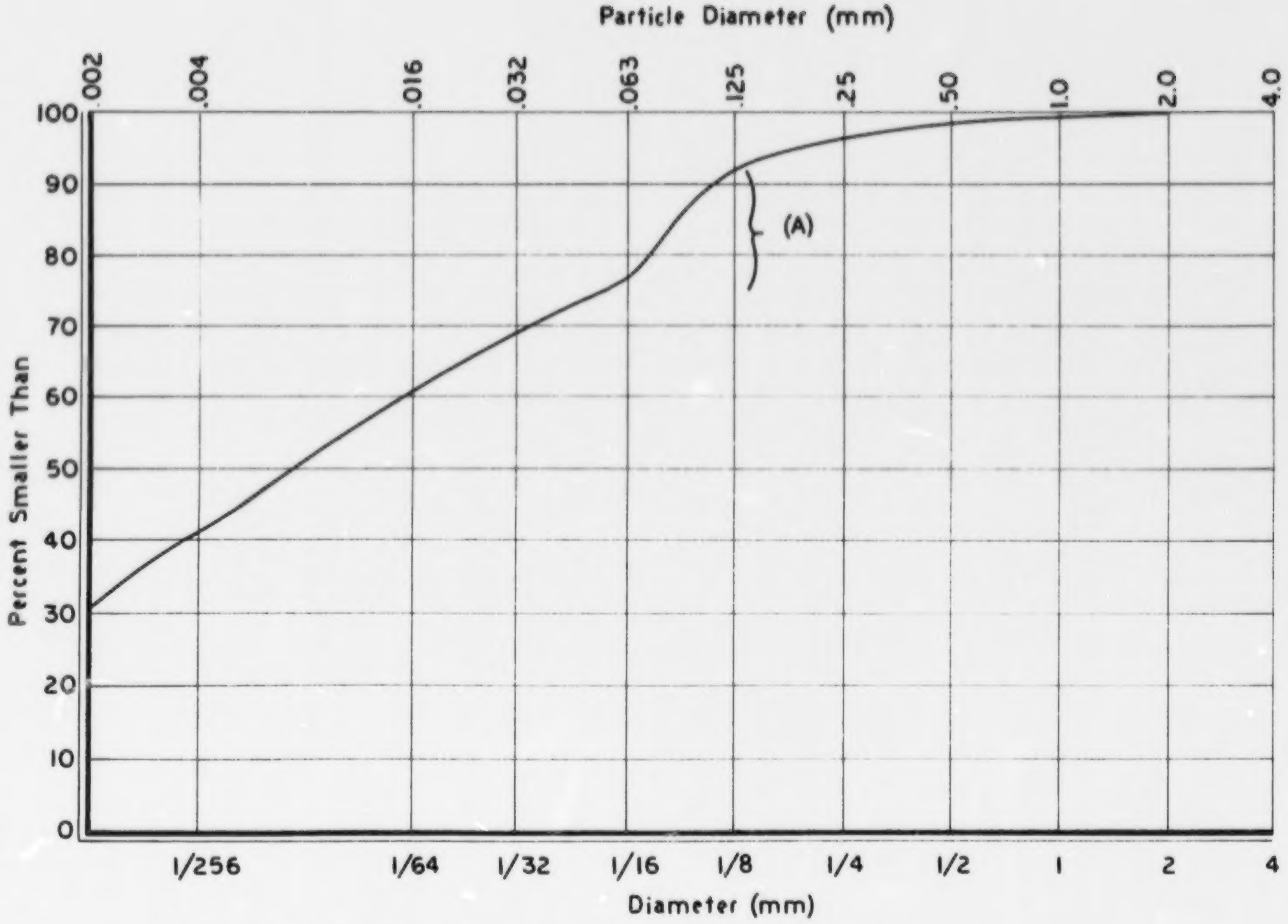


Figure 107. Cumulative frequency curve of grain size distribution of lacustrine enriched till: Strat Unit 7, 22 - 33 cm DBS.

cm below the surface. The slope of the curve shows the poorly sorted nature of the deposit and the presence of lacustrine sand enrichment in the very fine sand fraction. This is shown as (a) in the figure.

The mode of deposition, given the poor sorting evident in the sample, is likely the same as in Strat Unit 6 and is probably a type of water-lubricated mass movement. In the ground, this sample was taken from the Ah/Ck soil mix and shows the typically churned appearance of the molded lacustrine sand, till and contained organics. This unit represents a zone of accumulation of colluvial materials.

Figure 108 gives cumulative frequency curves showing sorting in deposits comprising two buried paleosols at the base of the scarp. As in the previous examples, the samples show the influence of lacustrine enrichment and the poor sorting evident in the depositional medium of these sediments. The method of deposition here, as in the upper portions of Strat Units 6 and 7, is probably a form of viscous flow. The sequence of buried paleosols at the scarp base illustrates periods of separate, discrete flow episodes.

At DlMa-1, one is dealing with a poorly or nonsorting depositional mechanism operating over a nonsorted till landsurface. Although sedimentological methods are not sufficient within themselves to confirm the mode of deposition on such a till landscape, in combination with other sources of information, they indicate a type of water-lubricated mass movement. These other sources of information include: 1) the presence of paleosols at the scarp base, where slumping is not likely to have been a significant erosional factor in comparatively recent times because the slope of the scarp is low; 2) the churned, contorted appearance of the deposits at the scarp base and in portions of the adjoining slope which suggest a type of viscous flow; and 3) at least one mass movement "scar" on the upper portion of the terrace scarp.

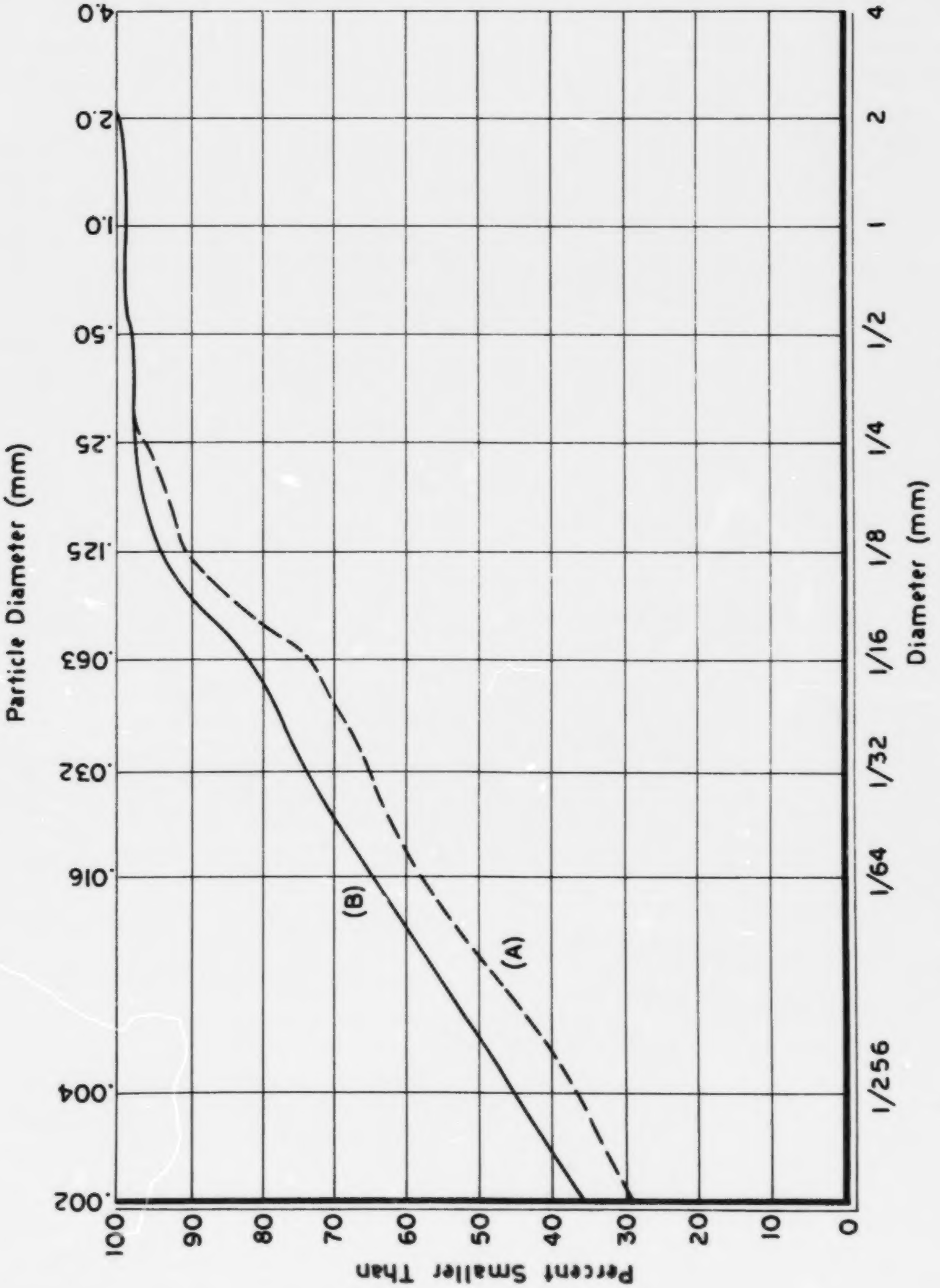


Figure 108. Cumulative frequency curves in Unit ON 104E

APPENDIX VII

SELECTED WALL PROFILES

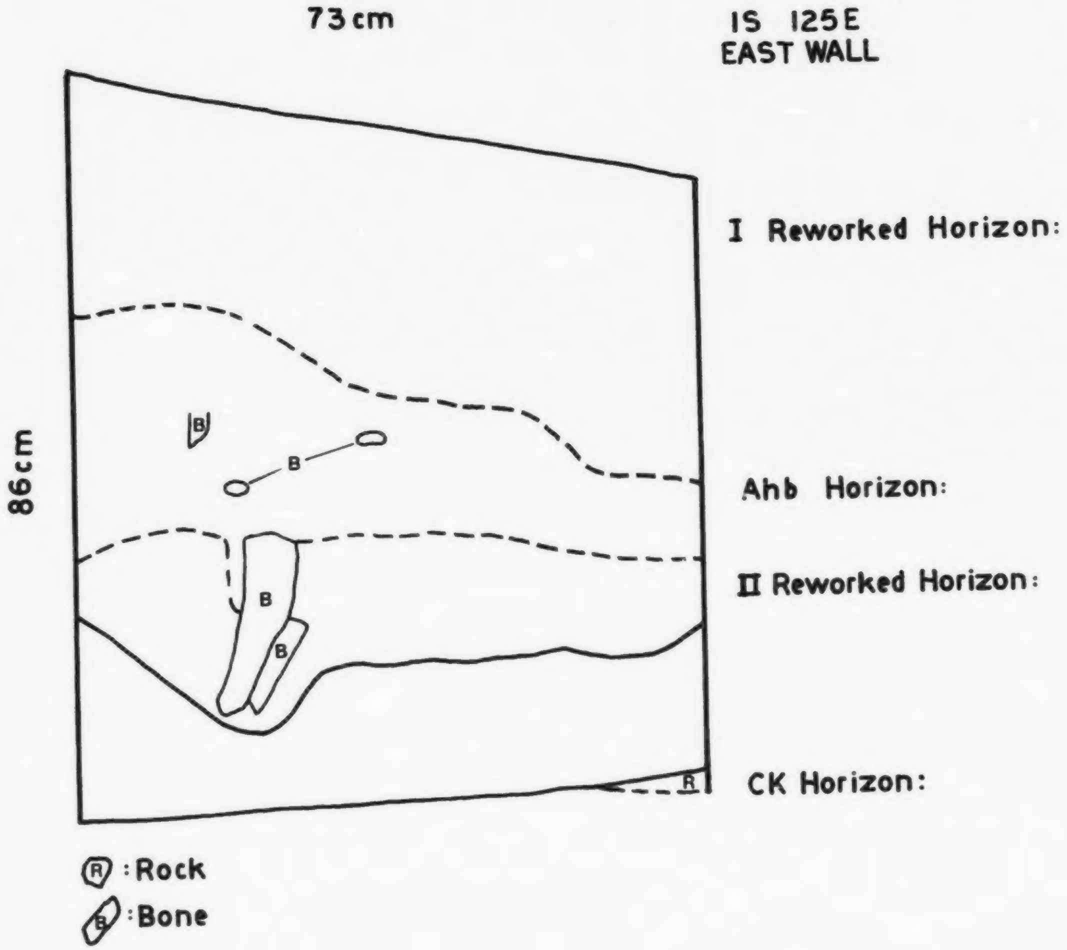

73cm
1S 125E
EAST WALL
86cm
I Reworked Horizon:
B
B
Ahb Horizon:
II Reworked Horizon:
B
B
CK Horizon:
R
R :Rock
B :Bone

Figure 109. Unit 102 - 1S 125E, east wall.

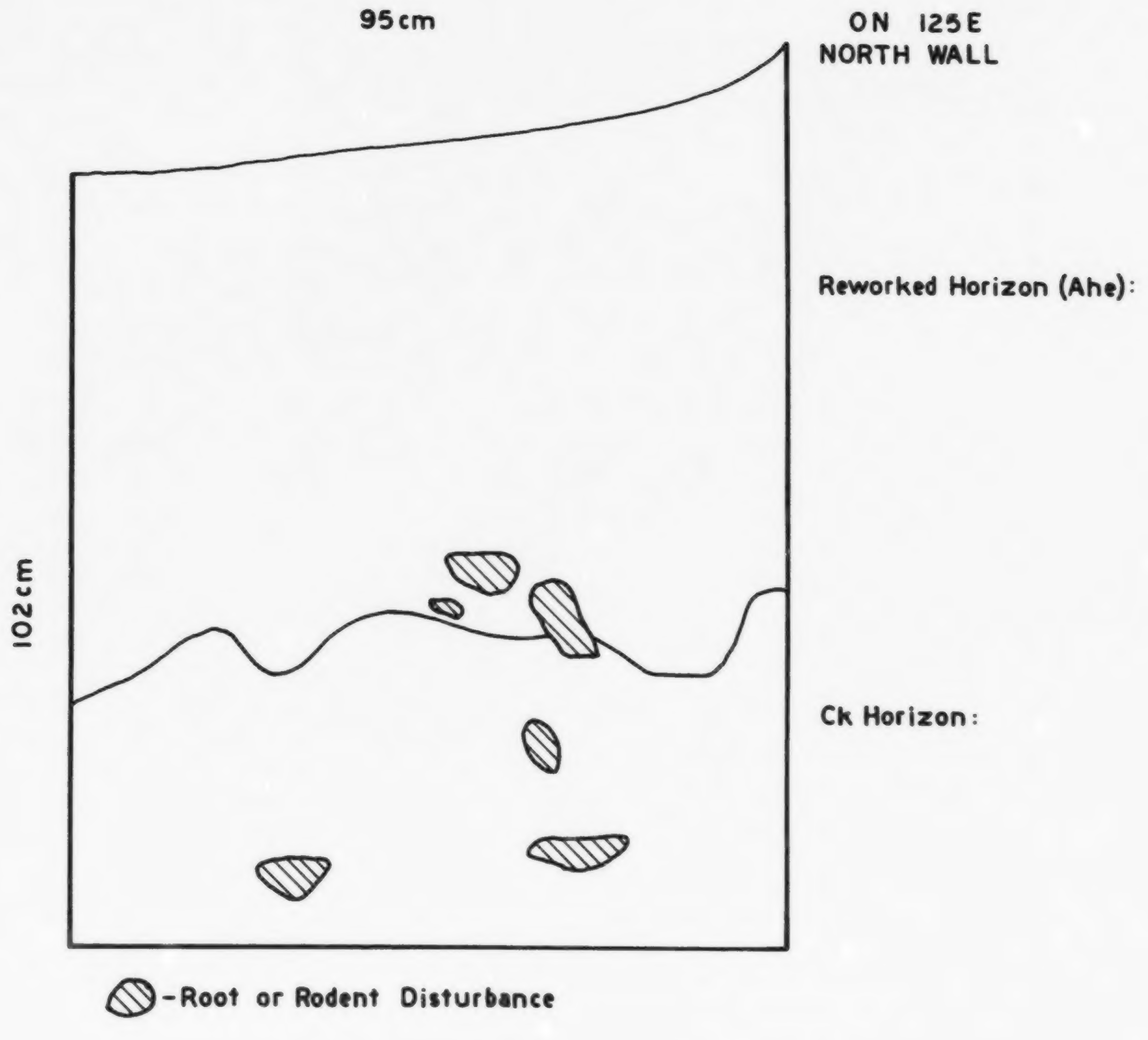

95cm
ON 125E
NORTH WALL
Reworked Horizon (Ahe):
102cm
Ck Horizon:
▨-Root or Rodent Disturbance

Figure 110. Unit 103 - ON 125E, north wall.

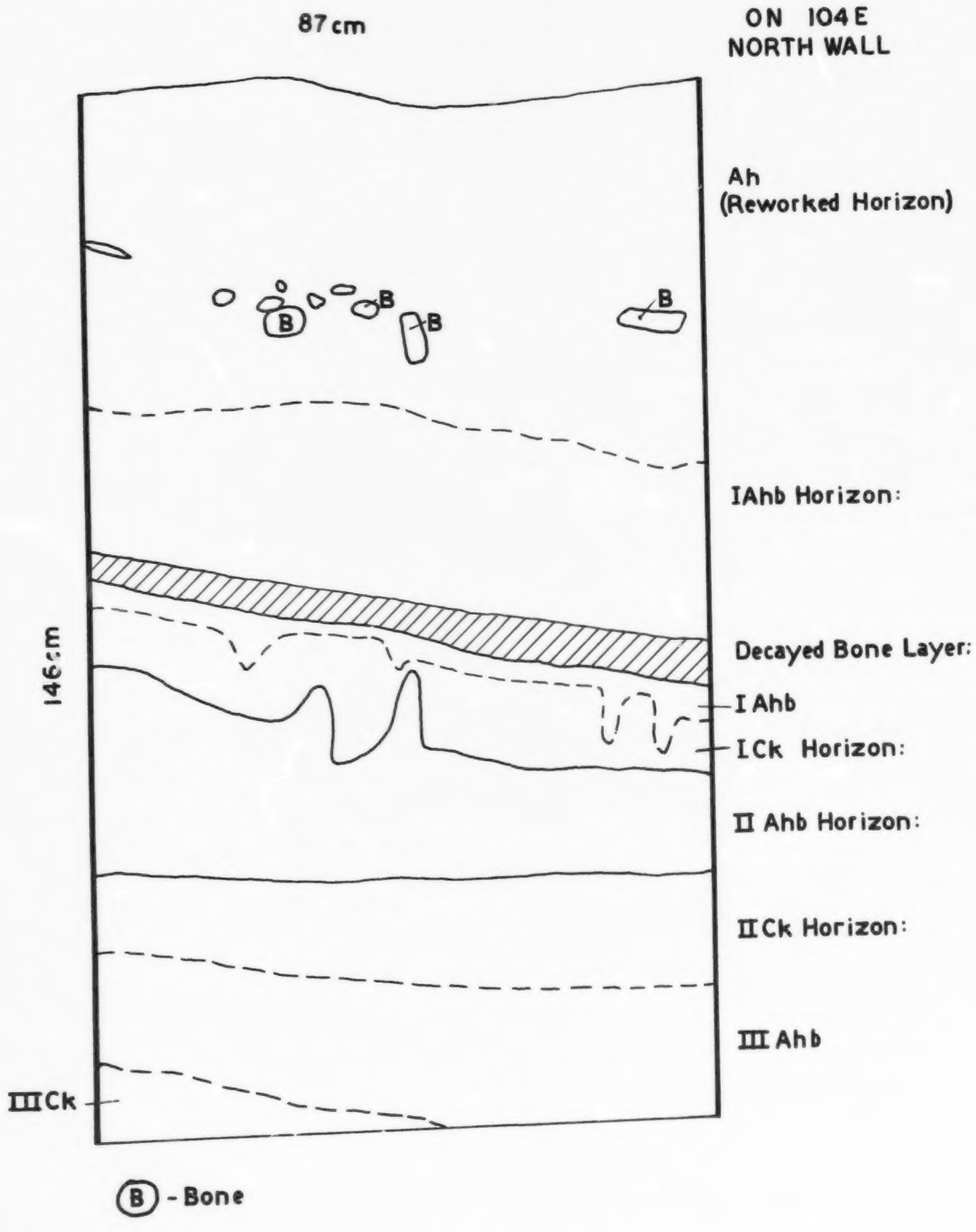

87cm
ON 104E
NORTH WALL
Ah
(Reworked Horizon)
B
B
B
B
IAhb Horizon:
Decayed Bone Layer:
146cm
I Ahb
ICk Horizon:
II Ahb Horizon:
IICk Horizon:
III Ahb
IIICk
B - Bone

Figure 111. Unit 99 - ON 104E, north wall.

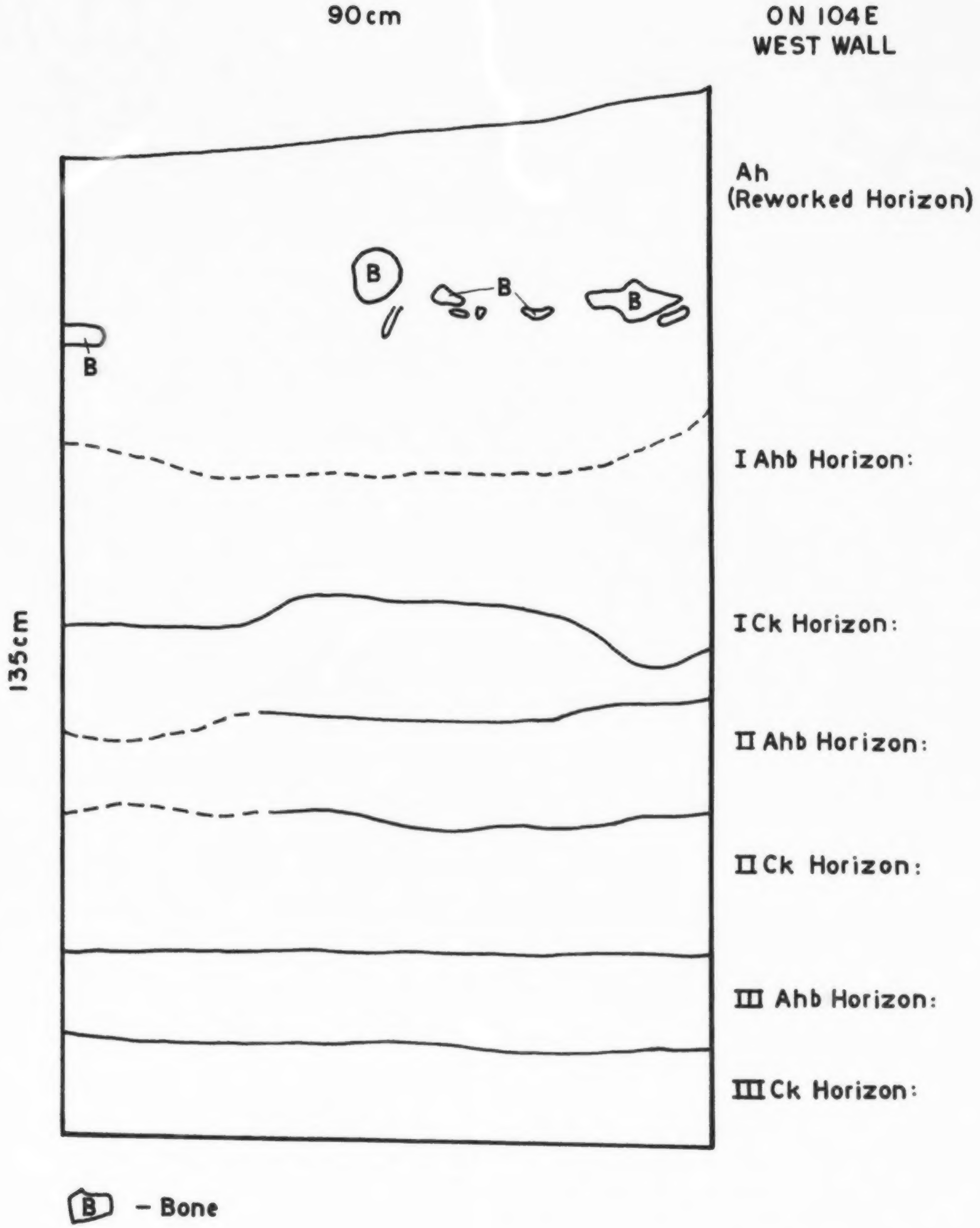

90cm
ON 104E
WEST WALL
Ah
(Reworked Horizon)
B
B
B
B
I Ahb Horizon:
135cm
I Ck Horizon:
II Ahb Horizon:
II Ck Horizon:
III Ahb Horizon:
III Ck Horizon:
B – Bone

Figure 112. Unit 99 - 0N 104E, west wall.

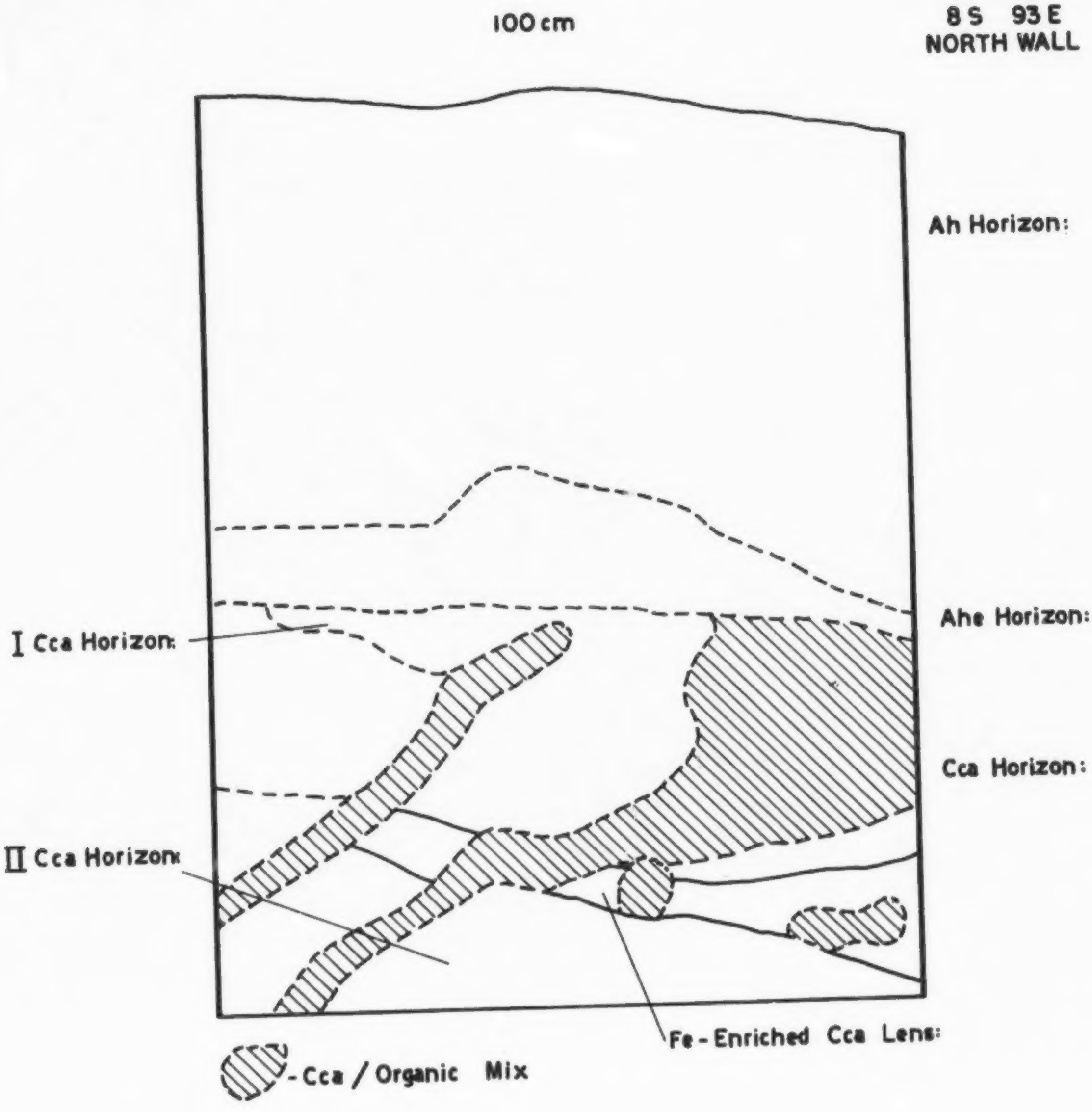

100cm
8S 93E
NORTH WALL
Ah Horizon:
Ahe Horizon:
I Cca Horizon:
Cca Horizon:
II Cca Horizon:
Fe-Enriched Cca Lens:
-Cca / Organic Mix

Figure 113. Unit 125 - 8S 93E, north wall.

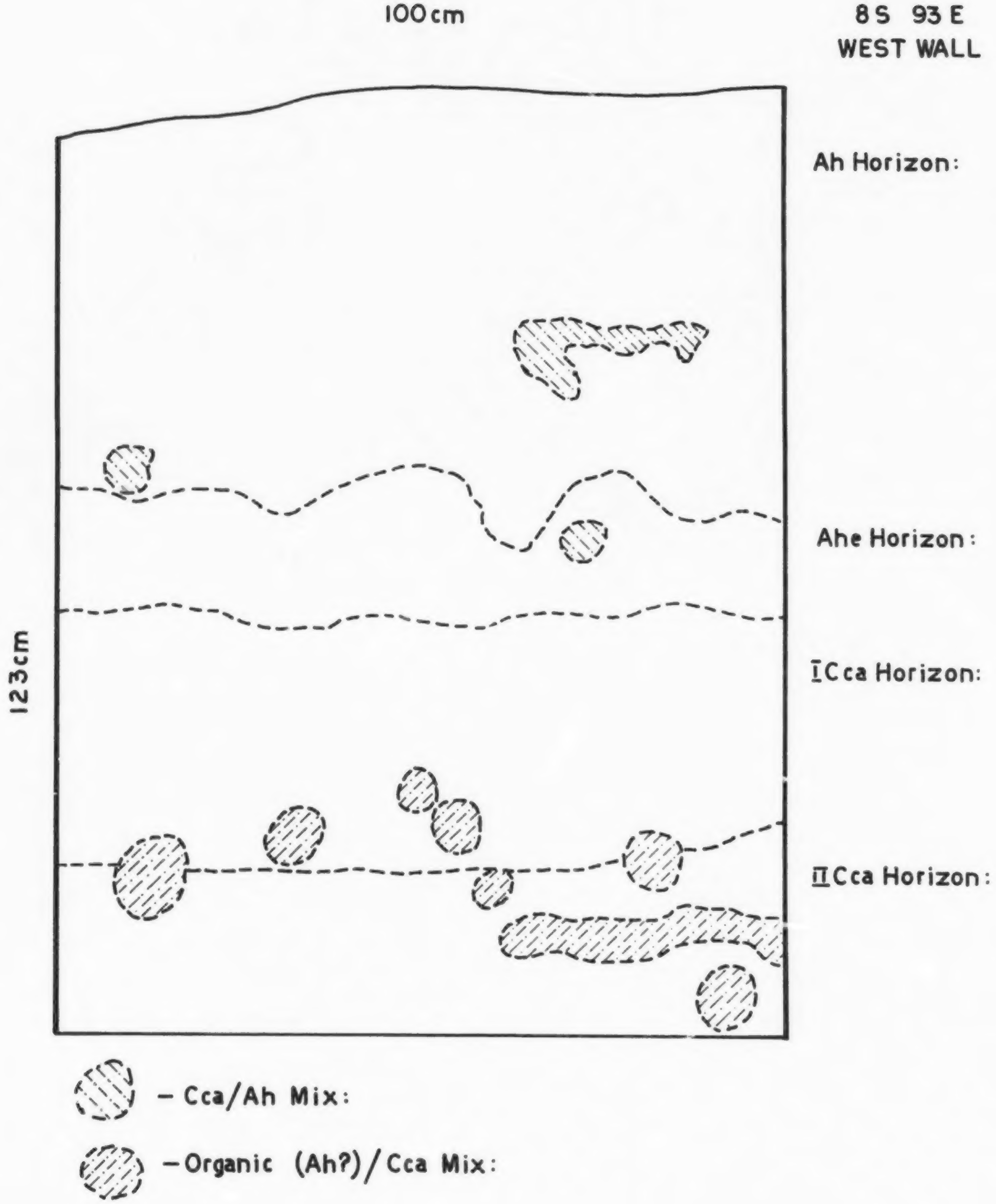

100cm
8S 93E
WEST WALL
Ah Horizon:
Ahe Horizon:
ICca Horizon:
IICca Horizon:
123cm
– Cca/Ah Mix:
– Organic (Ah?)/Cca Mix:

Figure 114. Unit 125 - 8S 93E, west wall.

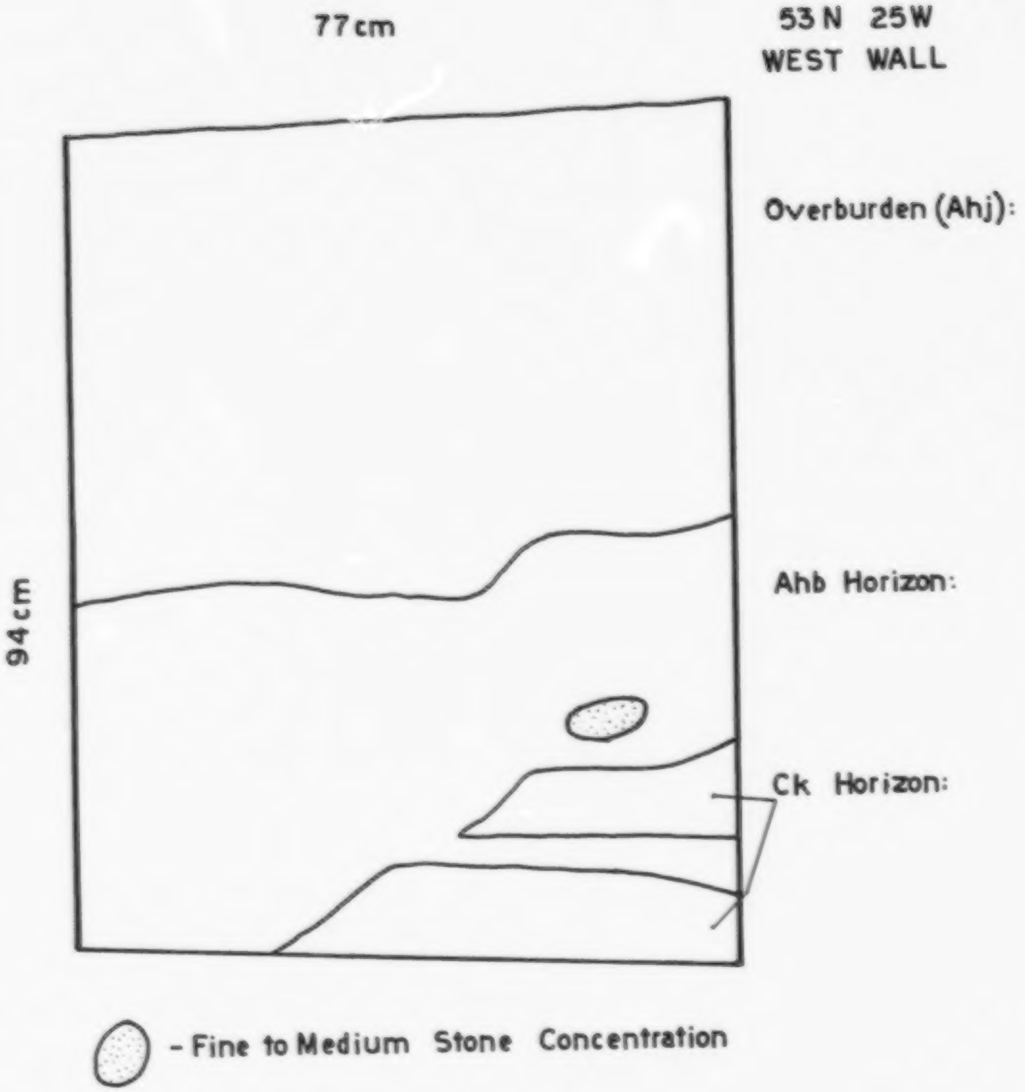

77cm
53N 25W
WEST WALL
Overburden (Ahj):
Ahb Horizon:
94cm
Ck Horizon:
- Fine to Medium Stone Concentration

Figure 115. Unit 109 - 53N 25W, west wall.

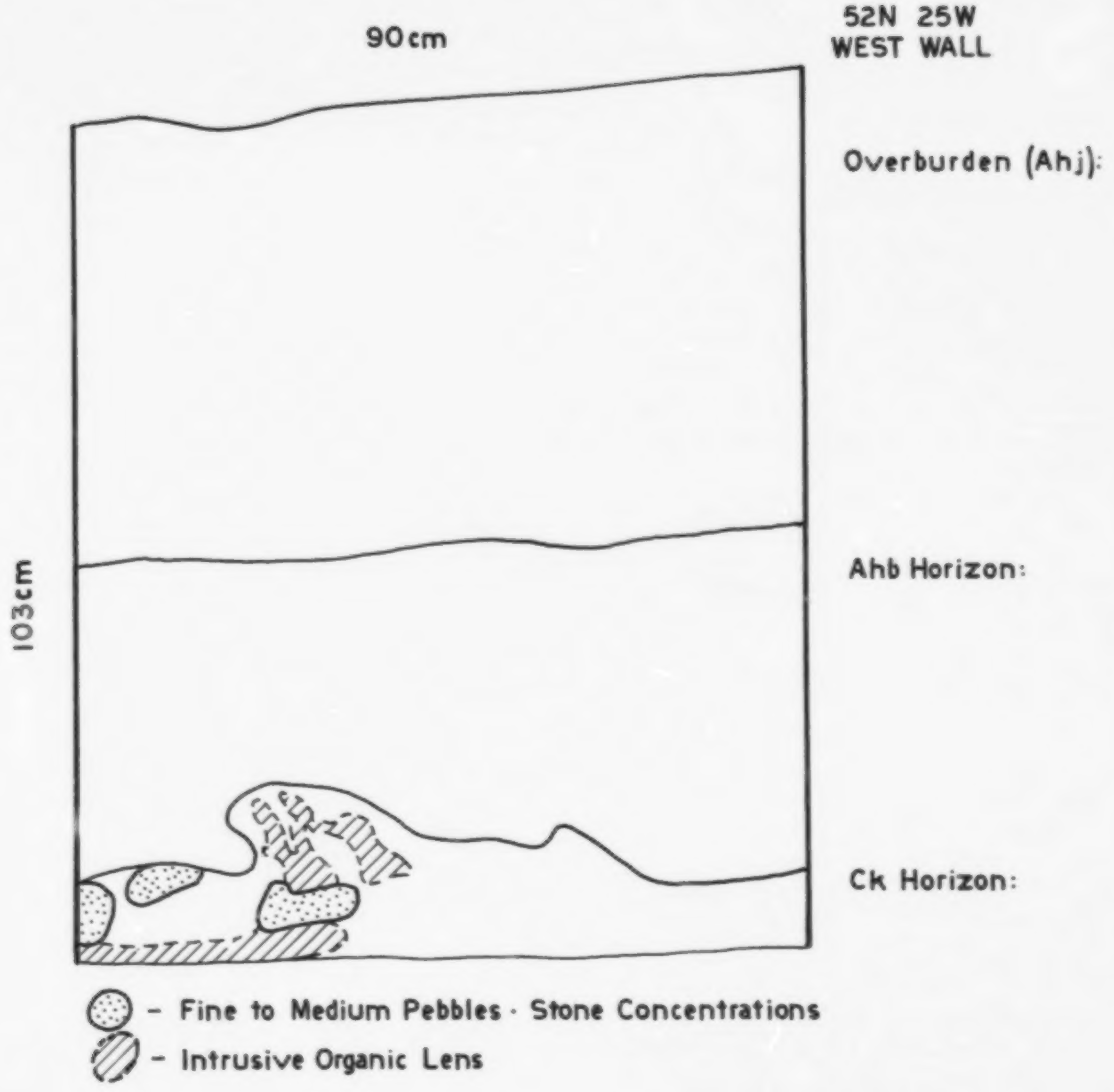

90cm
52N 25W
WEST WALL
Overburden (Ahj):
103cm
Ahb Horizon:
Ck Horizon:
- Fine to Medium Pebbles · Stone Concentrations
- Intrusive Organic Lens

Figure 116. Unit 108 - 52N 25W, west wall.

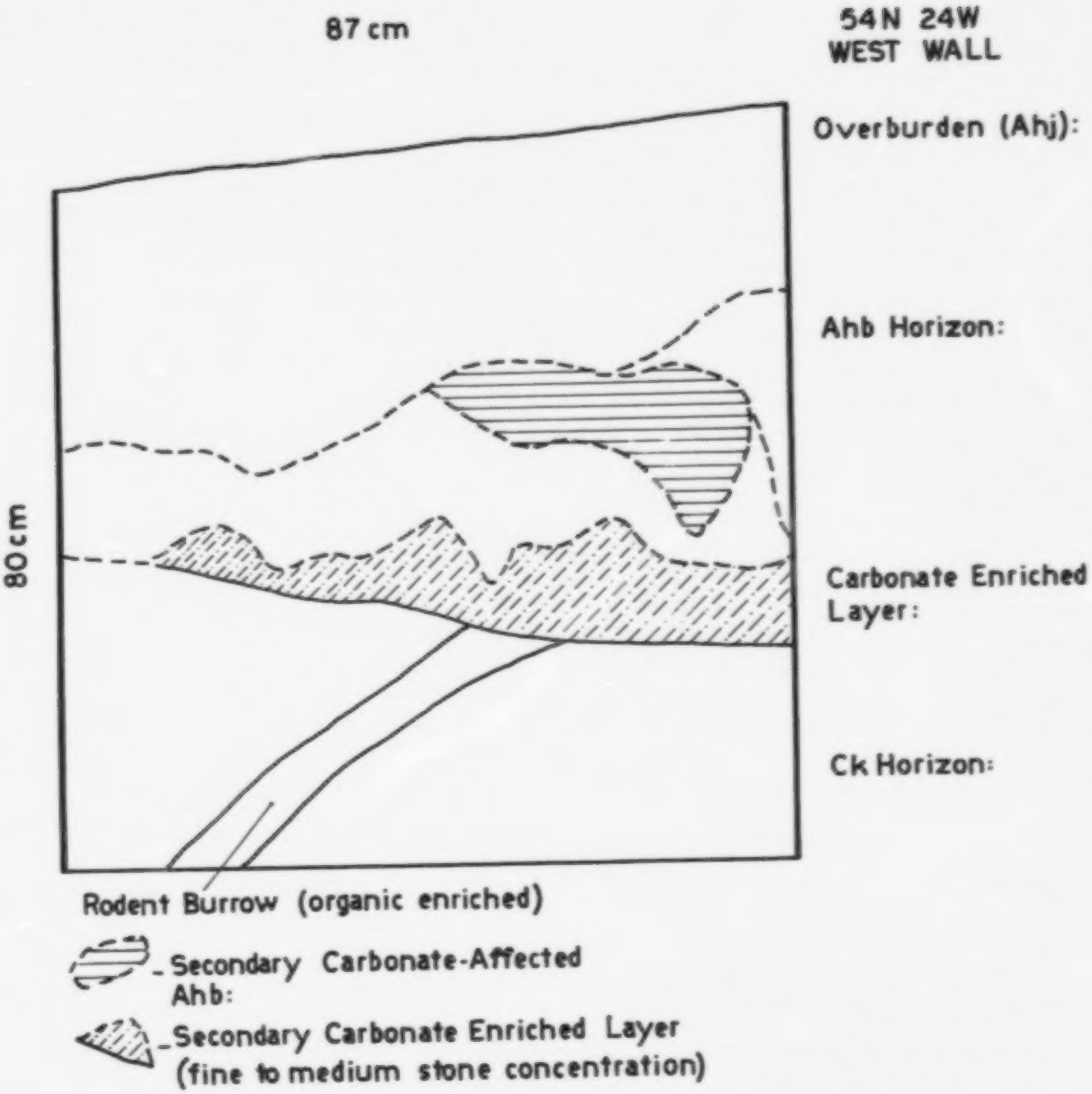

87 cm
54N 24W
WEST WALL
Overburden (Ahj):
Ahb Horizon:
80 cm
Carbonate Enriched Layer:
Ck Horizon:
Rodent Burrow (organic enriched)
Secondary Carbonate-Affected Ahb:
Secondary Carbonate Enriched Layer (fine to medium stone concentration)

Figure 117. Unit 105 - 54N 24W, west wall.

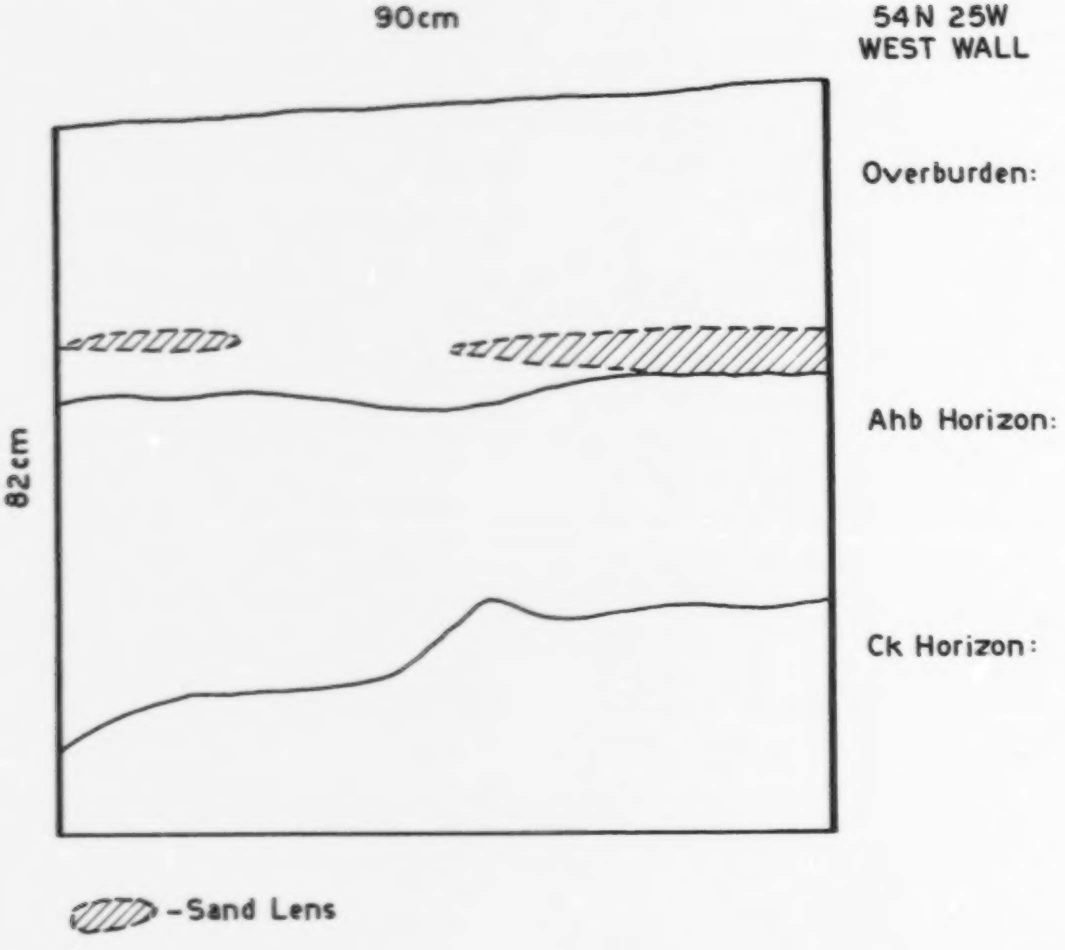

90cm
54N 25W
WEST WALL
Overburden:
Ahb Horizon:
Ck Horizon:
82cm
-Sand Lens

Figure 118. Unit 110 - 54N 25W, west wall.

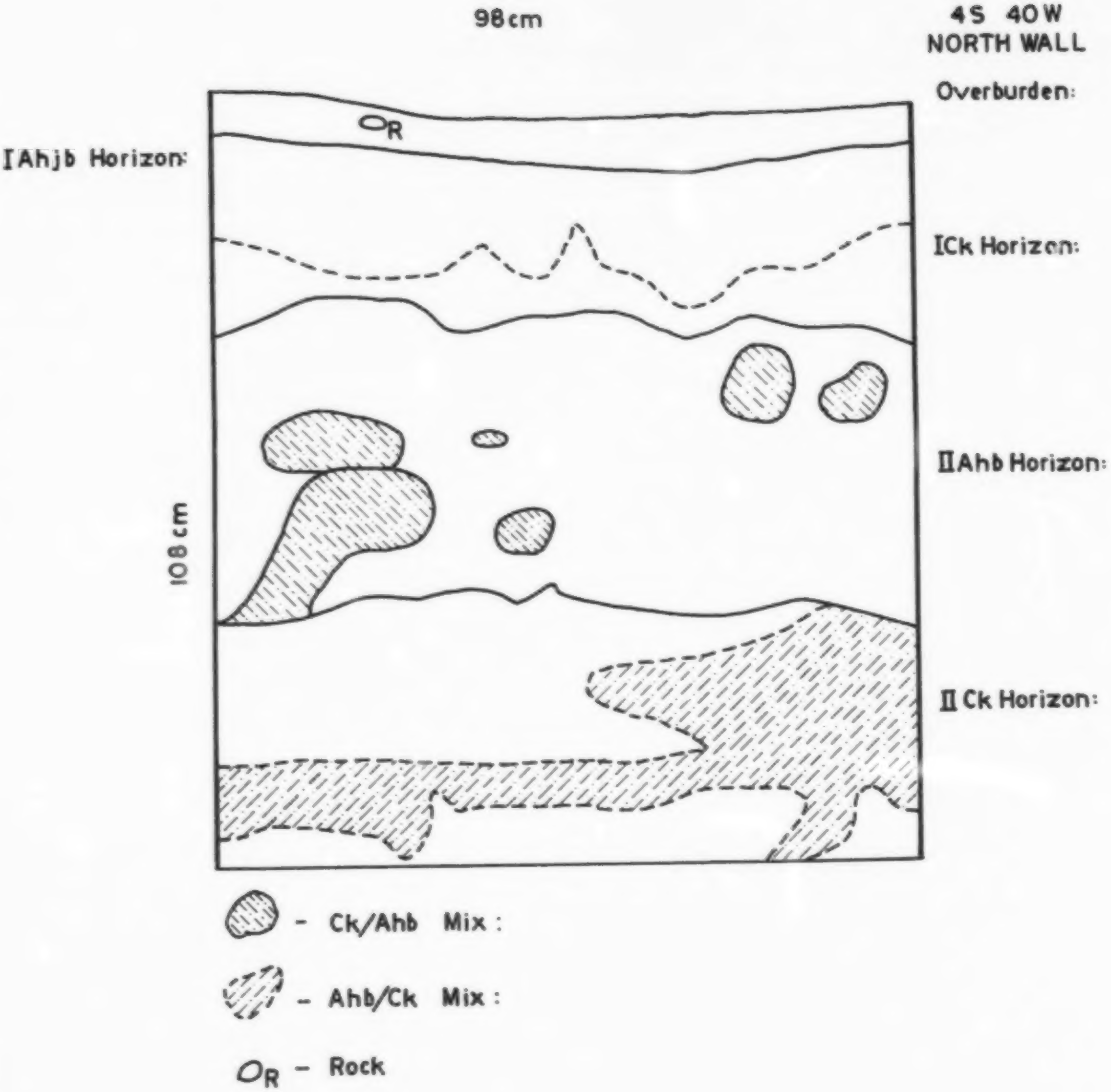

98cm
4S 40W
NORTH WALL
Overburden:
OR
I Ahjb Horizon:
I Ck Horizon:
II Ahb Horizon:
108cm
II Ck Horizon:
- Ck/Ahb Mix :
- Ahb/Ck Mix :
OR - Rock

Figure 119. Unit 116 - 4S 40W, north wall.

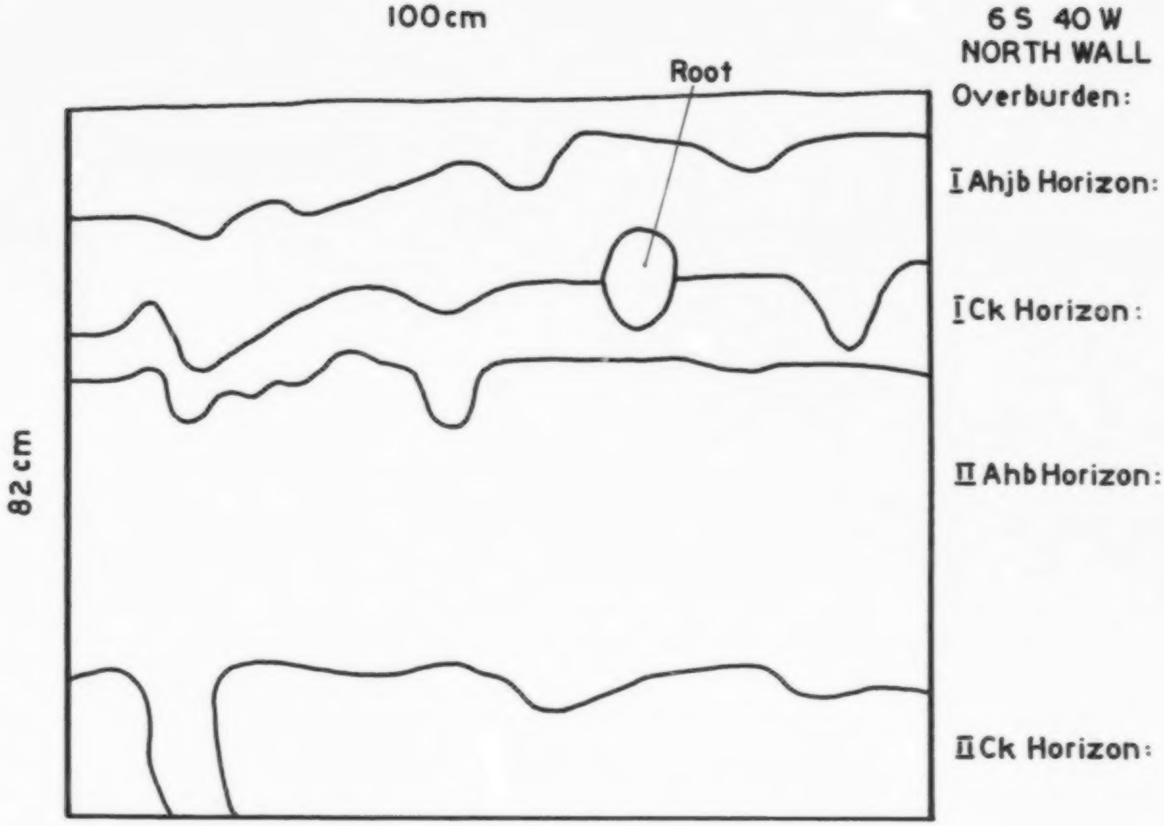

100cm
6S 40W
NORTH WALL
Root
Overburden:
I Ahjb Horizon:
I Ck Horizon:
82 cm
II Ahb Horizon:
II Ck Horizon:

Figure 120. Unit 114 - 6S 40W, north wall.

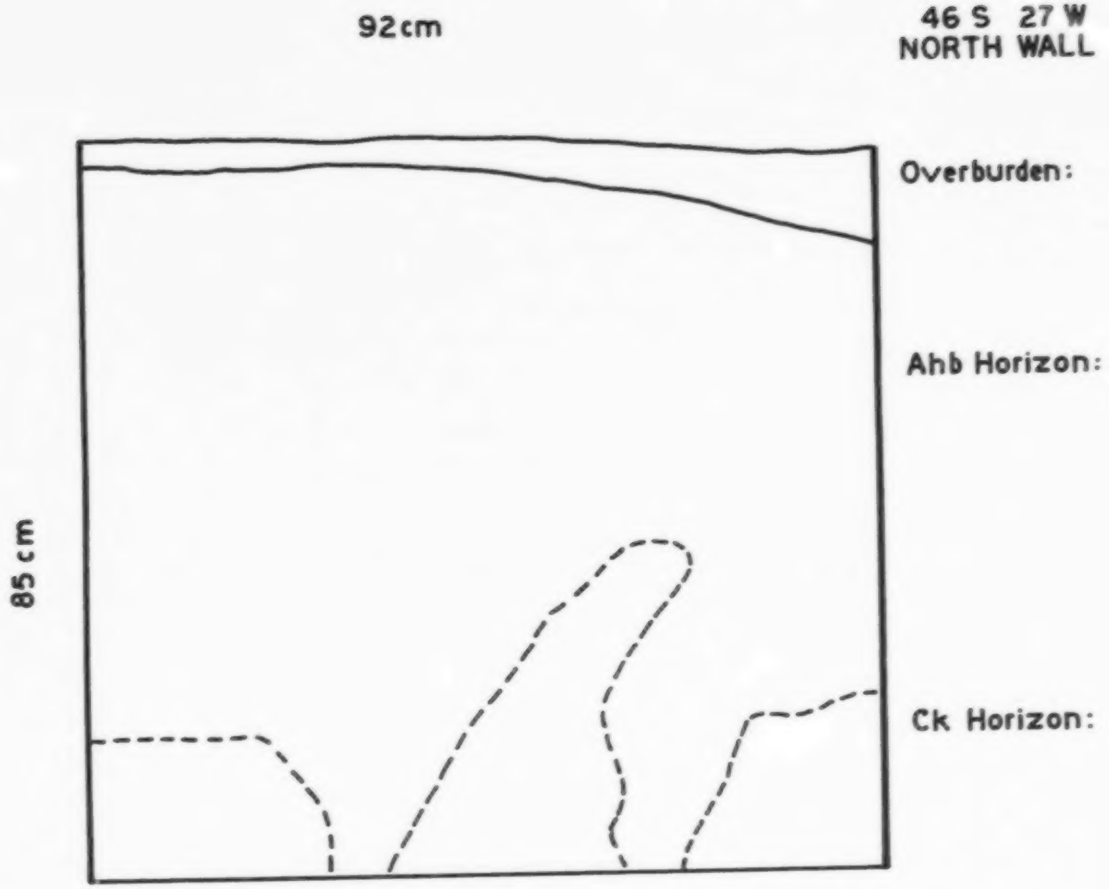

92cm
46 S 27 W
NORTH WALL
Overburden:
Ahb Horizon:
85 cm
Ck Horizon:

Figure 121. Unit 121 - 46S 27W, north wall.

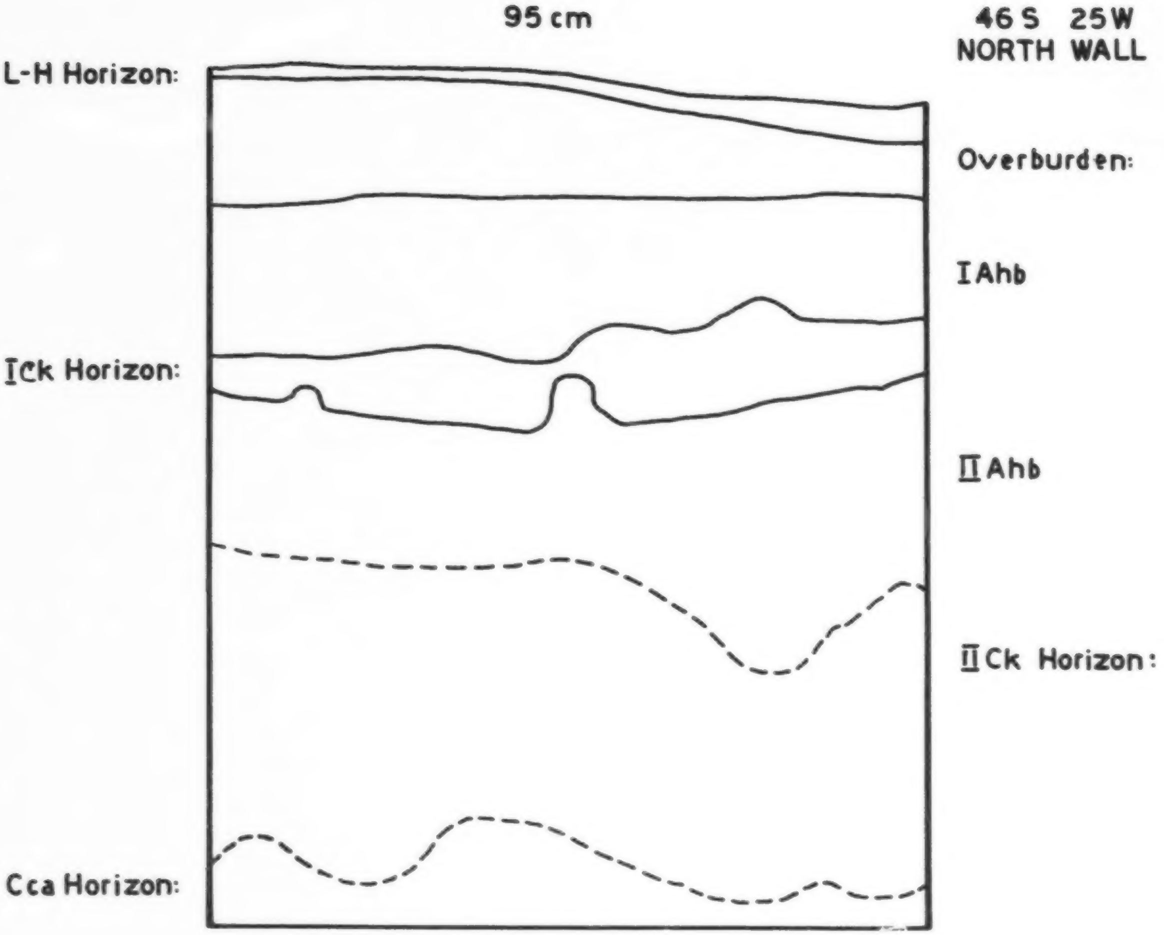

95 cm
46 S 25 W
NORTH WALL
L-H Horizon:
Overburden:
I Ahb
I Ck Horizon:
II Ahb
II Ck Horizon:
Cca Horizon:

Figure 122. Unit 119 - 46S 25W, north wall.